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POWER EQUIPMENT IN THE J. L. MOTT CO. WORKS

STOKER FIRING, ELECTRIC DRIVING AND EXHAUST HEATING

By HARRY H. YATES

AS AN example of the successful operation of a central power house and distribution of power by means of wires and motors, instead of shafting and belts, as is done in many factories, and the superiority of the former over the latter system, the plant of the J. L. Mott Co. stands out prominently.

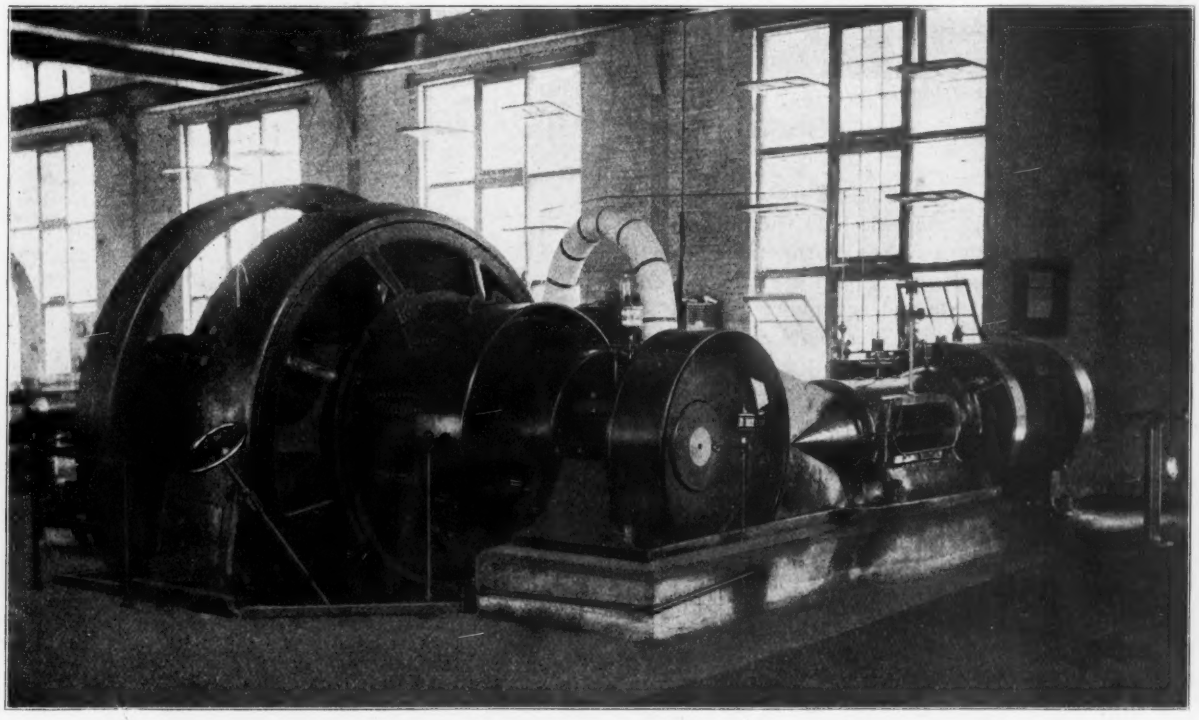


FIG. I. BUCKEYE ENGINE UNIT IN THE MAIN ENGINE ROOM OF THE MOTT IRON WORKS

This concern, for many years located in Mott Haven, New York, gradually outgrew its quarters, and real estate in that vicinity becoming too valuable for manufacturing purposes, it was decided to move to a more suitable location and erect a modern and up-to-date plant.

Location

The city of Trenton, N. J., being in close proximity

to New York and Philadelphia, on the main line of the Pennsylvania R. R., offering every facility for shipment of raw materials and finished product, as well as lower cost of ground and taxes, was finally decided upon as the best location for the new plant, and a large plot of ground, in the southern part of the city, on the east bank of the Delaware & Raritan canal, and on the line of the Camden & Amboy division, was secured. Upon this have been erected 10 large buildings of brick and reinforced concrete construction.

General Arrangement of Power Plant

Of particular interest to the readers of Practical Engineer is the power house, which is about 60 by 150 ft., located at about the center of the plant. The

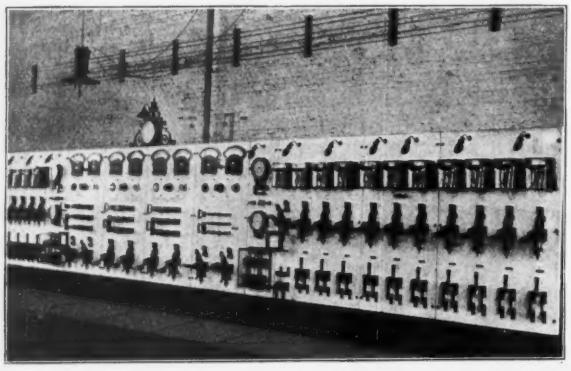


FIG. 3. THE MAIN SWITCHBOARD

first floor is occupied by the boiler room, L, air compressors, A, pump, P, and pipe lines, running the full length of the building and being below ground level, while the engines and switchboard are situated on a platform at ground level and occupying about 1/3 of the area of the building. This platform is of iron, supported by heavy concrete piers, the engine foundations extending through, to and below the basement floor. The space between the piers and foundations is utilized for the steam and exhaust pipes, some of the pumps, and the oil filter.

Engine Room

Power for driving the plant is furnished by 3 15.5 and 26.5 by 27-in. cross-compound Buckeye engines B C D, running at 120 r. p. m., direct-connected to 220-volt, General Electric, direct-current generators of 200 kw. capacity; 1 8 by 12-in. simple Buckeye, E, at 280 r. p. m. with a 40-kw. generator of the same make, and 2 Ingersoll-Sergeant air compressors, A, 1 2-stage, compressing to 100 lb. for operating drills, hammers, riveters, hoists and sifters, as well as blowing out generator coils and switchboard instruments, etc.; the other at 30 lb. for the sandblast, which is used for removing sand and scale from castings. These compressors are located in the end of the basement farthest from the boilers, and can be reached by steps leading from the engine platform. The air intake pipe is elevated about 20 ft. above ground to insure clean air.

A 15-ton capacity, hand-power crane traverses the full length of the engine room, affording convenient handling of heavy machinery.

Steam pipes of all the engines are led through the floor by use of the 180-deg. bends shown, deliver the steam to the engine without abruptly changing its direction. Close to the low-pressure cylinder, Fig. 1, can be seen the wheel of the valve disconnecting the engine from the exhaust pipe.

Switchboard

In the eastern end of the engine room, near the wall separating it from the boiler room, is the switchboard, which is of white marble and consists of 12 panels, Fig. 2.

Four panels in the middle are for the generators, and are equipped with the usual volt and ammeter, pilot light, rheostat, voltmeter switch, double-throw main and equalizer switches and 2 single-pole circuit breakers. A noteworthy feature of these panels is that all meters and pilot lights are set flush with the board, all meters having transparent, illuminated dials. One of the voltmeters, by a special arrangement and switch, can be connected to any generator or to the power or light side of the board.

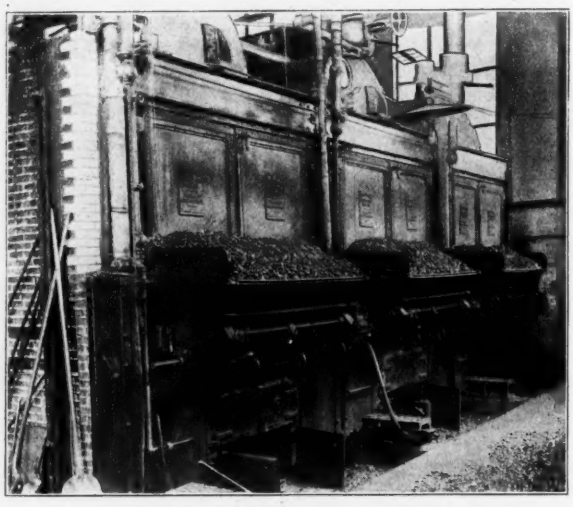


FIG. 4. FRANKLIN STOKER-FIRED WATER-TUBE BOILER PLANT

Four panels to the right of the generator panels and the right side of the double-throw switches are on the lighting circuits, the corresponding ones on the left are for power purposes.

On either side of and next to the generator panels is one containing the recording instruments, a Bristol volt and ammeter and a Thomson wattmeter, which tell the amount of power required by the power and lighting circuits.

Next to these panels are the distributing panels, 3

in number, containing instruments for 11 circuits, each circuit being supplied with a wattmeter, circuit-breaker and switch.

The bus bars are of the usual construction, but fitted so that in case of light loads the lighting system can be supplied with current from the power side of the board, or vice versa, making it unnecessary, in such a case, to run more than 1 engine.

Connections to the high-pressure air line can be seen between the meters on the 2 outside generator panels, also in the middle of each set of distributing panels, which, by simply attaching a hose, afford a convenient means of removing any dust from the board and instruments.

from a Cochrane heater, K, at about 170 deg. In the line between the pumps and economizers is a water meter, N, usually by-passed, but which can be used for testing purposes.

Piping

The main pipe, 12-in. diameter, is carried between piers beneath the engine room floor and forms a loop to which connections are made by bends of large radius, which, in fact, are used at all changes of direction, for the engines and air compressors. This loop can be divided into 2 sections so that, if necessary, repairs can be made without shutting down the whole plant.

All valves are of the gate pattern. The exhaust

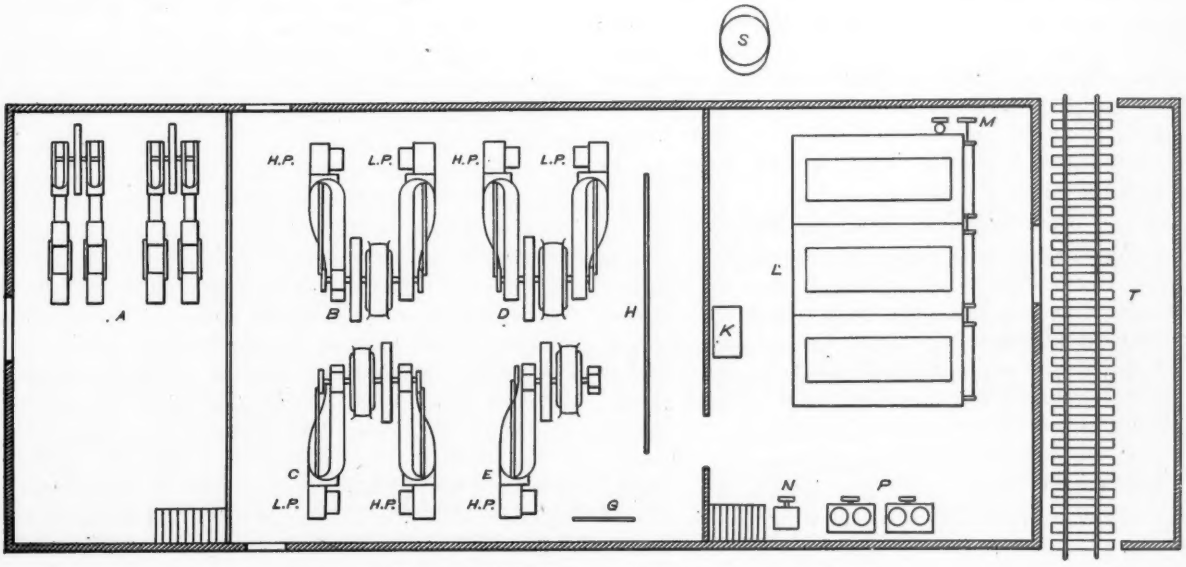


FIG. 2. PLAN OF ARRANGEMENT OF MOTT POWER PLANT

Near the right end of the switchboard and at right angles to it is a marble board, G, containing the steam, receiver heating system, vacuum and air pressure gages.

Boiler Room

The boiler room is reached from this corner of the engine room by steps leading down towards the front of the boilers, L.

Three 350-h. p. Franklin water-tube boilers furnish the steam required. They are equipped with Roney stokers, burning gas coal screenings. Each boiler is fitted with two 4-in. pop valves set at 150 lb., 140 being the pressure carried, and with the usual complement of water columns, gages, etc.

The boilers are connected to the 12-in. header by 8-in., 180-deg. bends of large radius, a gate valve being placed close to the boiler.

Back of the boilers are Green economizers, which heat the water to about 260 deg. Natural draft is used and is supplied by a brick stack 180 ft. high.

Feed water is supplied by two 7.5 by 5 by 12-in. vertical Dean duplex pumps, P, which take the water

main, to which all engines and air compressors are connected, is 16-in. diameter, and is carried beneath the center of the engine room floor to a point near the boilers where the steam is distributed to the various buildings or discharged through an exhaust head above the roof.

The buildings are equipped with the Warren-Webster vacuum system, all returns being removed by a vacuum pump and delivered to the heater from which the feed pumps get their supply. No trouble has been experienced from oil, the heater being quite efficient. All make-up water is automatically supplied. With the exception of very cold weather, the exhaust is sufficient to heat all buildings, live steam being added as necessary.

Coal is brought direct to the power house in cars and dumped into bins in front of the boilers, the consumption averaging about 25 tons per 24 hours.

The stoker hoppers are filled by hand, this being cared for by a fireman and coal passer for each shift of 12 hours. Ash is removed by hand and taken out of the boiler room by a Link Belt elevator.

Oil Filtering System

In the basement, under the engine platform, is located the filtering apparatus to which all drains from the engines are connected. Part of this was designed by the chief engineer, and is a practical illustration of what simple means can accomplish. A series of three tanks, of about 40 gal. capacity each, is arranged in steps, about 6 in. between levels; all drain pipes empty into the first one, which allows the oil and water to separate, also some of the dirt to settle, when it can be washed out by the occasional opening of a valve in the bottom. Oil and water levels are kept constant by a system of pipes properly placed, the oil descending from 1 tank to another until it finally reaches a Cross filter made by the Burt Mfg. Co., which is hardly necessary, as the oil from the last tank, upon being tested, showed hardly a trace of impurities. The tanks were designed only to remove the worst of the dirt and thus save cleaning the filter so often, but work so well that the filter seems almost superfluous. From the filter, the oil is drawn as needed to fill cans and cups.

Distribution of Power and Material

Tunnels connecting with the various buildings lead from this basement, all pipes and wires being placed in them, making inspection and repairs less difficult. The yard is traversed by standard gage tracks, and cars, after delivery by the railroad company, can be taken by an electric "driller," operated by 2 25-hp. motors which obtain current from an overhead trolley, and placed where most convenient for loading and unloading.

There are altogether about 32 motors, ranging from 5 to 50 hp., which furnish power to run the various shops, the foundry requiring power for cupola blast, cranes, the cleaning and grinding of castings. The pattern, machine, brass finishing, cabinet, carpenter and other shops all requiring power in various amounts which tend to create considerable demand on the generators.

Products Manufactured

This concern manufactures all kinds of plumbing supplies, from common pipe fittings to the finest nickel plated valves and attachments, the plating requiring the use of a motor-generator set which reduces the voltage to that required for the process; this department also requires considerable power, as besides the current used for plating, numerous emery, buffing and polishing wheels have to be provided for. Bath and toilet rooms of all kinds are furnished complete in enameled iron, fit for the finest as well as the more moderate establishment, everything necessary, including the cabinet work, being turned out by this company.

The photographs and plan sketch of the power house will, it is hoped, be of some assistance in explaining the location of the machinery.

For facts and figures used in writing this article the writer is indebted to John F. Lightford, the chief engineer, who rendered all assistance possible.

PIPING STEAM TRAPS

ARRANGEMENT, CONNECTIONS AND FOUNDATIONS

By W. H. Wakeman

WHILE conversing with an ex-steamfitter who is now an expert machinist, I mentioned the fact that steam appliances are frequently located and piped so that it is inconvenient to handle them in daily service and difficult to make adjustments and repairs when they are needed. He replied that when he worked as a steamfitter he protested against some of the plans submitted for his guidance, as the arrangements were not practical. In reply to this he was informed that his business was to place the appliances, and do the piping as directed. If anybody wanted to remove them later on, it was their business to find a way to do it.

A Bad Setting

The steamfitter who set the 3 traps shown in Fig. 1 evidently had this idea in mind, as the piping is arranged in the most inconvenient way possible, and when it becomes necessary to adjust or repair the internal parts calling for the removal of many bolts, there are but few of them that can be reached in a workmanlike manner with a wrench, because the vertical pipes are so near them, and valve stems and wheels are found where there should be only clear spaces.

Each trap is fitted with 1 inlet valve, as shown at 2, 3, and 4, also an outlet valve, 5, 6 and 7. An emergency, or bypass valve is also provided for each, see 8, 9 and 10. Therefore, if a trap is disabled when it is not convenient to repair it, the inlet and outlet valves are closed and the bypass is used to regulate the escape of water from the heating apparatus to which it is attached, until repairs are completed.

One of my former employers taught me this axiom: "If you catch me once it is your fault, but if you catch me twice it is mine." As these traps are located in my plant I found myself "caught" the first time they needed attention and the work made necessary by their removal is still remembered, especially as the whole outfit is located in very close quarters. When they required repairs the second time I concluded not to be caught twice, hence proceeded to make the following improvements.

Improving The Arrangement

The small trap at the right hand was taken down

and set on a new pier built for it, as shown in Fig. 2. No vertical pipe is near enough to prevent the free use of a wrench in removing the bolts, and the valves are located where they are readily accessible.

The larger trap (of a different type), shown at the left hand in Fig. 1, was taken away and used elsewhere. The tilting trap, illustrated in Fig. 3, was substituted and a brick pier built to support it. There

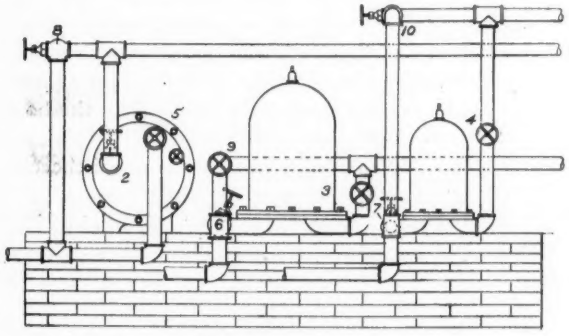


FIG. 1. THREE TRAPS AS A BAD EXAMPLE

is now room enough to walk entirely around it, and as the illustration demonstrates, the valves are placed where they are readily accessible, hence it is convenient to make adjustments and repairs at any time. The pipe line that this trap drains carries boiler pressure, therefore a tilting trap is suitable for this service.

Fig. 4 illustrates the central trap in Fig. 1, as it stands in its original place, but the piping has been changed and greatly improved. Both vertical pipes are now located so far away that a wrench can be used to remove the bolts and take off the top without inconvenience, making it possible to dismantle the trap, clean, adjust, or repair it in a short time without that

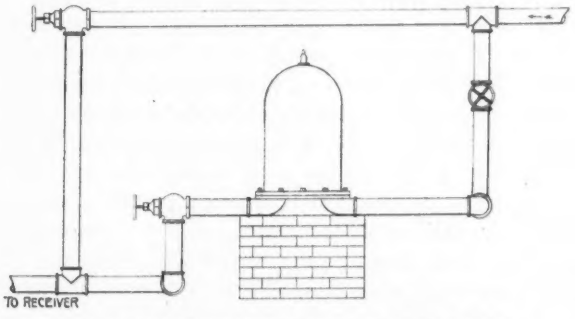


FIG. 2. SMALL TRAP WELL SET ON BRICK PIER

feeling of disgust and annoyance, which is much more harassing than a large amount of hard work under favorable conditions.

In order to further illustrate the improvement made in this case, Fig. 5 is presented. It is a plan view, showing the location on the ground floor of the 3 traps, together with all connecting pipes and valves. The main trap is shown at 2, resting on the center of the original pier, with inlet and outlet pipes on either side of it. When the reader considers that these pipes were originally close to the trap, (See Fig-1), and that 3 was located on the same pier instead

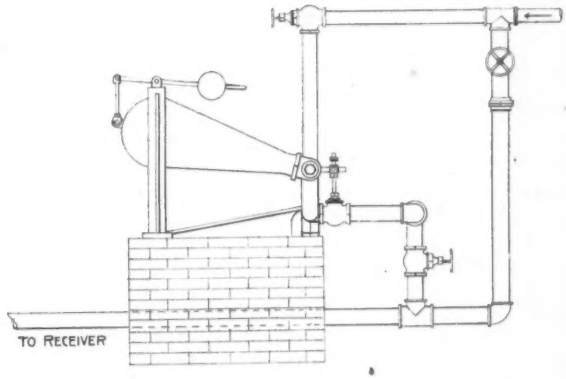


FIG. 3. ARRANGEMENT FOR A TILTING TRAP

of a separate one, as it now appears, and furthermore that there was another trap with its connecting pipes and controlling valves at the left of 2, the greater ease with which all of these important parts can be reached will be very plain.

I suggest that when changes are made in a system of piping, on either a large or small scale, the bonnets of all valves be removed and the internal parts thoroughly examined, as there is a chance at this time to make small repairs with little trouble, and if any of them are worn out they ought to be replaced. When a valve that is fitted with a hard rubber disk has been in use for several years, it usually needs a new disk,

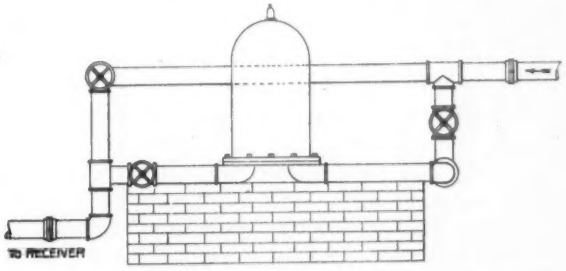


FIG. 4. CONNECTIONS FOR CONVENIENT HANDLING OF A TRAP

and while the bonnet can be removed at any time when pressure is off, there is no better time to do it than when the whole thing can be held in a vise and the necessary work done on a good bench.

Foundations

When an engineer wishes to make changes similar to those mentioned, it is not always convenient to secure the services of a mason to build small piers. If one can be secured, get him by all means, but if not, there is no good reason, under average conditions, why the contemplated improvement should be given up on this account. A few bricks are almost always

available, and a small bag of cement can be obtained at a store. Four pieces of board, 3 or 4 in. wide, and about 1 ft. long, nailed together, make a good frame for a screen, and an odd piece of mosquito wire netting is suitable for the bottom. A bushel of sand can be quickly screened with this device, and when 2 pailfuls of it are mixed with 1 of cement, and the whole given enough water to make it into a thick paste, it is ready for use. A good helper employed about the mill or shop, or a handy fireman, can build the piers good enough for all practical purposes.

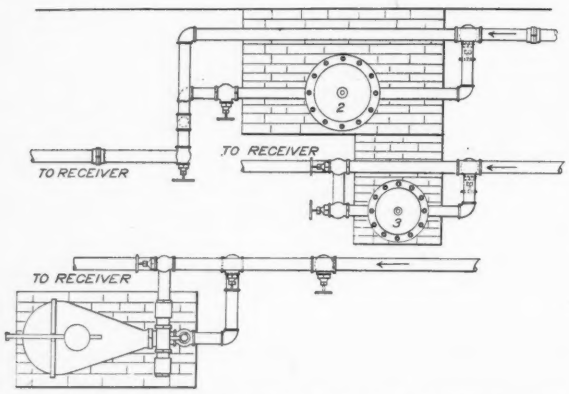


FIG. 5. PLAN OF IMPROVED ARRANGEMENT OF THE 3 TRAPS

If there are no bricks at hand make a wooden box the correct size for these piers, set it in place and fill it with hard burned clinkers, from the boiler furnace. Make the mixture of sand and cement thin enough to run into cracks and crevices, then pour it into the box and allow it to stand until it has hardened. Remove the box, and if the pier is rough, use some of the cement to fill the hollow places and make a smooth job. This is known as concrete (or at least one kind of it), and as it can be made into piers or blocks of any desired size at pleasure, proving durable in service, it is recommended accordingly.

WOOD AS FUEL FOR STEAM PURPOSES

VALUE OF WOOD AND PROPER FORM OF FURNACE

By F. W. Downs

WOOD in some form was probably the first fuel used by man, but is is plainly to be seen that even now its economical combustion is often not understood and seldom looked into, mostly on account of the ease with which it may be burned and sometimes the desire to get rid of it when it appears as refuse in wood working plants. Now, we are using a great deal of this former "refuse" in the manufacture of boxes, etc.

The writer has had varied experiences with wood in a number of electric light plants besides observing its use in saw mills and other wood-working establishments. In one plant we have used pine slabs, sawdust, shavings, hard wood, and coal, with the same load of engines, boilers, etc., which gave us a good basis to compare the performance of the different fuels, the only thing lacking, being sufficient draft to handle the cheaper grades of coal with a maximum load.

Heat Values

Herewith is a standard table showing the relative values of fuels as compared to soft coal:

One cord air dried hickory or hard maple weighs about 4,500 lb., equal to 2,000 lb. coal.

One cord air dried white oak weighs about 3,850 lb., equal to 1,700 lb. coal.

One cord air dried red or black oak weighs about 3,200 lb., equal to 1,400 lb. coal.

One cord air dried chestnut or elm weighs about 2,300 lb., equal to 1,050 lb. coal.

One cord air dried pine weighs about 2,000 lb., equal to 650 lb. coal.

From the above it would be safe to figure about 2.25 lb. wood equal to 1 lb. soft coal Pittsburg, R. O. P., Hocking and other equal grades. Our experience leads us to believe that the values given for white pine are nearly correct. For Norway pine it is safe to figure 1 cord equal to 0.5 ton of coal. The values of hardwoods are overestimated.

Advantages of Dutch Oven

At first glance it would seem that more of the heat would be uselessly radiated with a Dutch oven than with the fuel burned directly under the boiler; more heat is probably lost, but owing to the more perfect combustion it is not noticed. In the ordinary furnace, when the grates are set directly underneath the boiler the gases on rising strike the comparatively cold shell of the boiler, and imperfect combustion is the result; in the Dutch oven setting the top and sides reach a degree of heat that ignites the gases as they arise, thereby giving almost perfect combustion. Shavings and wood (when dry) will commence to burn from the top even before they ignite on the bottom.

Where green sawdust shavings and wood are used for steaming purposes it is necessary to use a Dutch oven when anything like rated capacity is to be got out of the boiler. If the fuel is of any value a Dutch oven will soon save more than its installation would cost. Properly built, with good fire brick and well tied with rods and buck staves, the oven will last for years without repairs other than would be required with the usual furnace.

Details of Furnace

For the arch proper, wedge fire brick of best quality and suitable taper should be secured; always use the wedge brick in preference to the regular arch brick, as it is better that the ends of brick should be next to fire. Ordinary brick can be used for the arch, but more stays will be needed, as the tendency for the arch to flatten is greater when the rectangular in place of the wedge brick is used.

The drawing herewith gives all the information needed by a competent bricklayer or mechanic to build a Dutch oven for horizontal tubular boilers. For two-flue Scotch boilers it is better to build two arches, one edge of each arch resting on a center wall whose thickness will equal the length of 1.5 fire brick.

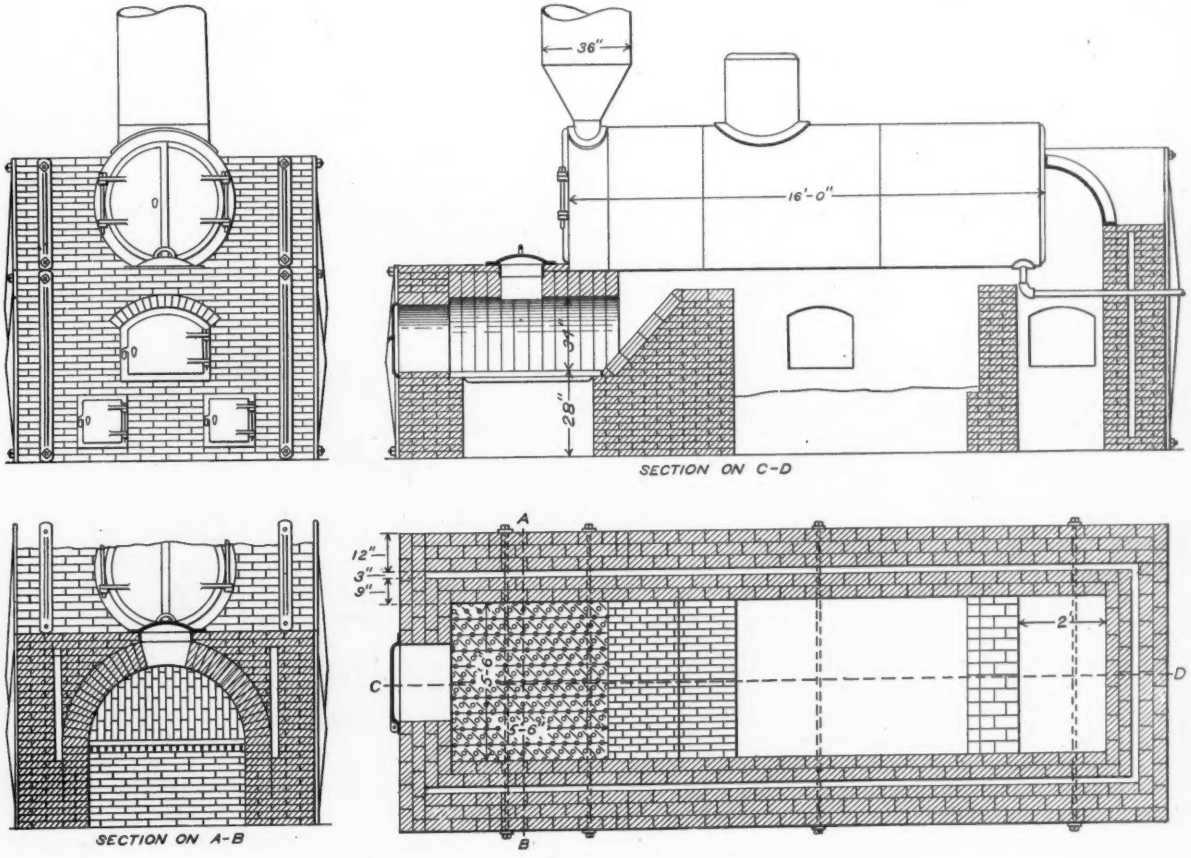
In burning sawdust or the like it is best to feed from the top of the oven; with wood it is necessary to fire from the front, the same as with the usual furnace.

Burning Sawdust

The best rig with sawdust or shavings is a conveyor running over the top of the oven, feeding the fuel in continuously, and rigged up to suit conditions.

On account of the oven holding heat so long, it is hard to clean the boiler or make repairs on short notice. Because wood needs less air than coal, the air space is usually made less in the grates than for coal; this is a mistake, as you can not get too much air space in your grates. With small air space the openings soon become filled up and the grates overheat.

Draft can easily be controlled with the ashpit doors. The proper management of a wood fire consists of getting the wood in straight and as close together as possible,—and letting it alone. With sawdust the fuel should be mostly in the center,—although this does not mean that the sides should be bare. With dry wood, shavings, or sawdust and a well built furnace the steaming capacity of a boiler is much greater than with coal.



DUTCH OVEN FURNACE FOR WOOD BURNING BOILER

ONE SQUARE FOOT OF HEATING SURFACE is needed in a boiler for every 200 cu. ft. of space in a church or hall. In a dwelling house, every 500 cu. ft. of space requires 1 sq. ft. of heating surface. Radiators should have 1 sq. ft. of superficial area to every 6 sq. ft. of glass in windows and 1 sq. ft. for every 80 cu. ft. of space to be heated. One horsepower in a boiler is generally sufficient for 40,000 cu. ft.

OIL BURNERS AND FURNACES

METHOD OF BURNING OIL AND RESULTS OBTAINED

IT is easy to make a burner which will break up or atomize oil to a sufficient degree to burn it more or less completely, and there are hundreds of such devices. The really good ones, however, are few in number and they divide into two classes—(a) outside mixers, (b) inside mixers.

Outside Mixing

A typical outside mixer burner is shown in Fig. 1. In this and similar burners the steam flows out from a horizontal slot or horizontal row of holes and the oil flows from a similar slot or row of holes placed

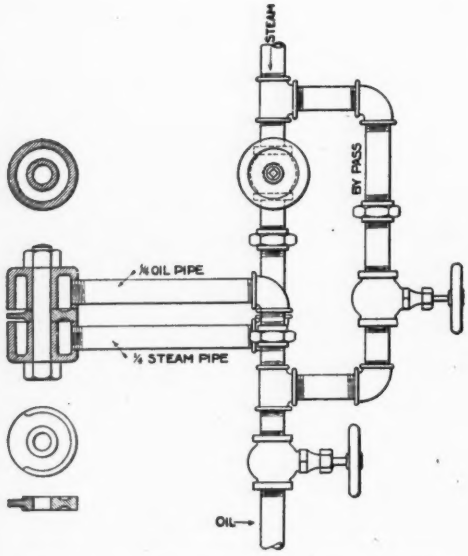


FIG. 1. TYPICAL OUTSIDE MIXER BURNER

higher up. The oil globules flow down on the jet of steam and are rolled along on the top film of this jet and the balance of the steam accomplishes nothing. In order to atomize the molecules to best advantage, the steam should tear through the oil so all the energy of the steam counts. If you had a lot of marbles and wanted to make them move with high velocity, you would want the propelling force to hit them squarely in the rear, just as a baseball bat strikes the ball. You would not lay them on a sheet of metal or a plank and then, by pulling in that sheet rapidly, impart velocity to the marbles—if you did that, the efficiency of the process would be very low. It certainly is low in the case of outside mixer oil burners, because the percentage of the total steam generated, which such burners use, is high, running from 3½ often to 8 and 9 per cent. This is a fact not generally recognized, but to cut off 2 per cent or more by reducing the steam consumed by the burner is just as important as to increase the evaporative efficiency 2 per cent. Further, all surplus steam shot into the fire box is just as detrimental as surplus air, as is evident.

In the outside mixer burner the oil and steam orifices are bound to wear, particularly the oil slots, owing to the greater or less quantity of grit always found in the oil, and for that reason such burners soon get out of condition and become still more wasteful, hence they have to be replaced; provision for taking up wear is not made and it hardly seems practicable to do so.

A particularly annoying trouble of this class of burner is the frequency with which it clogs up and its liability to carbonize in the oil orifices. Another trouble is that this type of burner cannot handle cold oil, or any heavy residuum or tar. This defect is of serious importance in cases where the supply of oil gets low and a fresh supply is dumped into the tank and there is no way to heat it immediately. In such cases plants using this type of burner must often shut down until the oil can be heated.

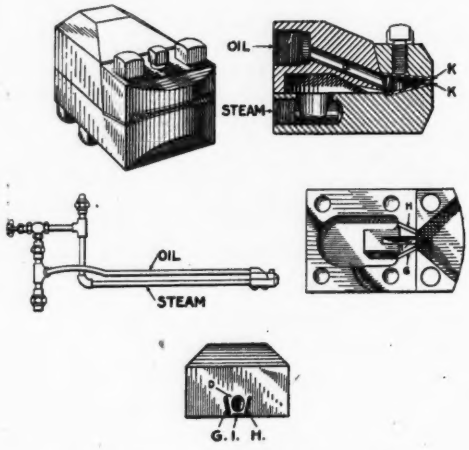


FIG. 2. DETAIL OF HAMMEL BURNER

On the other hand, the outside mixer type of burner is by far the easiest and cheapest to make, and the innumerable forms of it and the low price at which it is sold, in connection with the fact that the above stated defects are not generally recognized, is responsible for that type being so largely used.

Inside Mixing

The inside mixer burner is extremely more difficult to design properly, and while many attempts have been made to produce a successful one, nearly all of these attempts have been failures. After 14 years of experimental work Mr. Hammel finally produced the Hammel burner.

Figure 2 shows the Hammel burner in detail. Oil flows through the opening A down the channel D,

and three small steam jets, H, I and G, shown in the horizontal section, cut across this channel at an angle and thoroughly atomize the oil in the chamber C. The light hydrocarbons are vaporized in chamber C and the heavy hydrocarbons are atomized, the atomized mixture burning like a gas flame. There is no tendency to carbonize, as the only way by which this process can take place is to turn off the steam jet and leave the burner filled with oil instead of blowing it out. As each particle of steam cuts across the oil jet, the energy of the steam is fully utilized and the burner works with from 2 to 2½ per cent of the steam made by the boiler.

In case of any wear, due to dirty oil, the plates K, K, can be replaced in a few minutes, and as the plates are sold at 50 cents per dozen, the cost of rendering the burner as good as new is practically nothing.

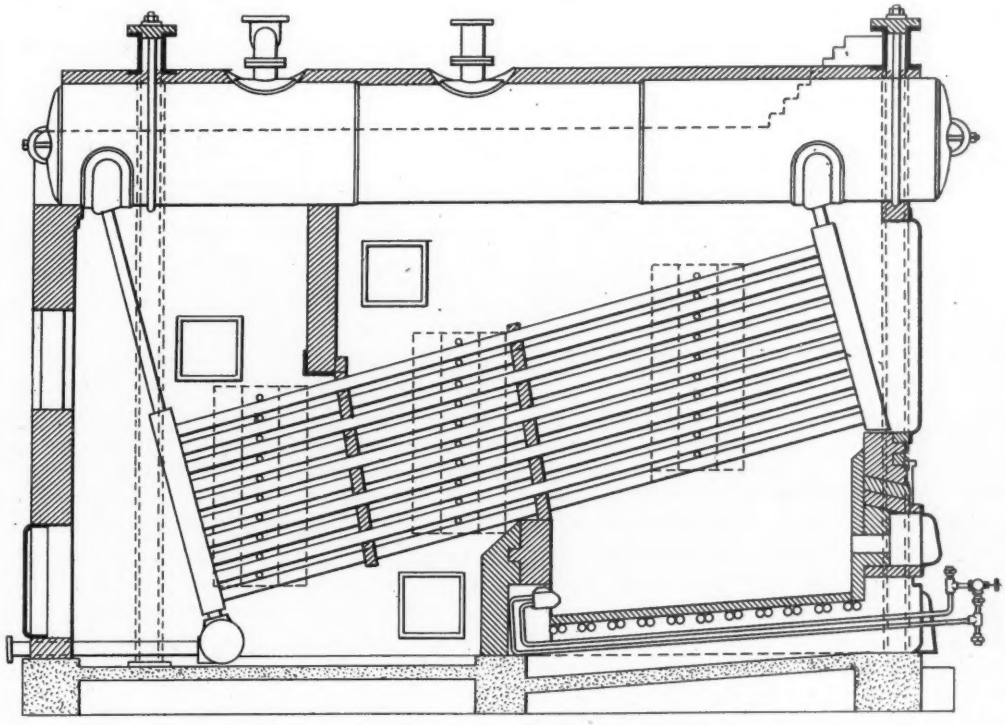


FIG. 3. BURNING OIL UNDER B. AND W. BOILER

Oil Burning Furnaces for Water-Tube Boilers

In the design of oil burning furnaces for water-tube boilers, the weak points of the arrangement hitherto used are: (1) inability to develop high efficiency, (2) frequent burning out of tubes, especially in horizontal types of water-tube boilers, (3) inability to operate at large overloads, particularly for long intervals, because of tubes burning, (4) carbonizing of oil in the orifices of the burners, (5) excessive repairs to furnace and to boilers.

After some experimenting, Mr. Peabody, of the Babcock & Wilcox Co., arrived at the method of firing from the bridgewall forward towards the boiler front, and this, in connection with certain changes in the furnace, developed a remarkable increase in boiler economy, provided all burners were operating at once, and it also decreased the burning of tubes, but not to a sufficient degree to solve that part of the problem satisfactorily, this latter feature being left for the solution of Mr. Hammel.

In Fig. 3 is illustrated an installation under a B. and W. boiler, from which the following will be gained:

The oil is fired from the bridgewall and the burner tubes are housed inside of a slot 4½ in. square, and this slot is in the back of an arched recess 2 ft. wide and 9 in. deep. The furnace floor consists of fire brick carried on pieces of old 2-in. pipe, or any convenient substitute; the furnace floor is made solid and is washed over with fire clay, except 14 narrow air slots through the deck and in front of each arch. Every burner, with its accompanying recess, has a separate air tunnel from the boiler front; these tunnels do not communicate in any way with each other under the furnace floor, and by closing off the ashpit door any tunnel can be sealed up, while the others are operating.

By this construction, the air supply to every burner is independent and the air passes up around the burner itself, in a sufficiently heated condition, and by the suction of the burner it is drawn to just the point where it is wanted. No other air enters except that which enters

through the narrow slots through the deck in front of the burner, and the reason for this is that without such admission of air, the flame is attracted downward and drags on the furnace floor. Just enough air is admitted to hold the flame up parallel to the deck and no more.

Perfect combustion is obtained and the surplus air reduced, and to such a degree is this true that by changing the opening of the ashpit door ¼ in. the effect on the flame is immediately seen. A feature entirely new and original with the Hammel people is the independent air supply to the burners, and on a wide boiler it is possible with this furnace arrangement to extinguish 1 or more burners and immediately to close off the air supply to these burners and to operate the others without reduction of their efficiency, which point is of the greatest importance in plants

TABLE—RESULTS OBTAINED IN OIL BURNING

Test	Boiler	Rate of Evaporation	Horse Power	Per Cent. Above Builders' Rating	Per Cent. Moisture in Steam	Temperature of Escaping Gases	Evaporation per lb. of Oil from and at 212°	Per Cent. Steam Used by Burners	Efficiency
1st Test.....	Babcock & Wilcox	3.85	532.7	14.1	0.21	438	16.02	1.96	83.06
1st Test.....	Stirling.....	3.58	341.0	1.8	0.56	454	15.31	3.42	79.16
2d Test.....	Babcock & Wilcox	4.52	625.2	33.9	0.14	464	15.66	2.33	80.64
2d Test.....	Stirling.....	4.55	433.6	29.4	0.52	517	14.87	2.72	76.73
3d Test.....	Babcock & Wilcox	5.86	810.6	73.6	0.16	525	15.22	2.27	79.37
3d Test.....	Stirling	5.68	541.0	61.5	0.58	606	14.26	2.50	74.05
Capacity Test	Babcock & Wilcox	7.11	983.9	110.7	0.14	622	14.22	2.13	73.62
Capacity Test	Stirling.....	6.94	661.2	97.4	0.69	720	13.85	2.10	71.50

carrying variable loads, and for boilers on stand-by service.

Some Data on Operation of Burner

In the accompanying table is a summary of the principal results obtained from tests made on B. and W. and Stirling boilers, the former having the furnaces fired from the rear while the Stirling had the old arrangement of firing from the front. The difference in results is apparent. When these tests were made, separate control of air for each burner was not arranged and the results today with a furnace embodying the latest improvements show even a greater difference.

BUYING OF COAL has, by a large number of firms in Chicago, been reduced to a scientific basis, the purchase being made on specification as to number of heat units contained per pound and percentage of ash. Analysis of the coal is made by an independent company called the Fuel Engineering Co., which samples and tests coal once a week at each plant where the contract is in force. The specification calls for a certain number of B. t. u. per penny cost of the coal and this value is determined as follows: Multiply the number of B. t. u. per pound of dry coal by the percentage of moisture expressed in decimals and subtract the product so found from the total number of B. t. u. per pound of dry coal; multiply the remainder by the contract rate per ton expressed in cents plus one-fourth of the ash percentage.

TUBE SETTING

TUBES give so much trouble from leakage that, regardless of the cause of leaks, engineers are always looking for some better method of making a tight joint between the tube and the tube sheet. The result of all the discussion, criticism and suggestion on this subject in this country has been to bring about a fairly uniform method of doing the work. Fig. 1 shows the method used by the Union Pacific R. R.

It is absolutely necessary for a good job that all scale should be carefully removed from the end of the tube and from the inside of the hole of the tube sheet. A copper ferrule, or shim, is then inserted in the hole and expanded lightly in place. This ferrule should either be flush with the fire side of the tube sheet, or, better still, should have about 1/32-in. chamfer from the tube sheet towards the inside of the boiler. The

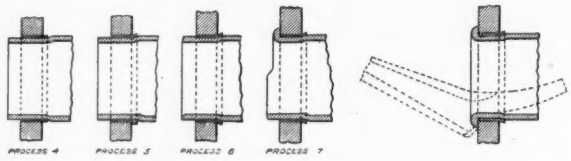


FIG. 1. METHODS OF TUBE SETTING USED BY THE UNION PACIFIC R. R..

other end of the ferrule should project a slight distance into the boiler, not more than ⅛ in. The tube is then inserted and expanded in place, the end projecting about ¼ in. through the tube sheet.

There is some difference of opinion among boiler makers in this country regarding the use of a roller expander, whether it should be used before or after the sectional expander has been used, or whether it should be used at all. These differences of opinion are, however, of minor importance. The main thing to be remembered is that excessive use of the roller

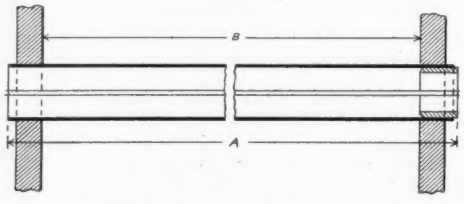


FIG. 2. METHOD OF SETTING TUBES USED BY SOME ENGLISH RAILROADS

expander tends to wear out the end of the tube and make it so thin that its life is very much shortened.

After the flue has been brought in perfect contact with the sheet the further use of the expander or roller will not make the flue any tighter, but will reduce the thickness of the metal and decrease its ductility. The less work done on a flue, the longer it will last.

The Lancashire & Yorkshire R. R. of England use

a ferrule in the firebox end of the tube, as shown in Fig. 2. The ferrules are welded and made from Swedish high-carbon steel, and are driven in by an ordinary drift pin. The tube is not beaded over. The firebox tube plate is of copper 1 in. thick, while the front tube sheet is of steel ⅞ in. thick.

The Royal Bavarian State R. R. uses a copper safe end on an iron tube. The safe end of the tube, as can be seen from Fig. 3, is very much strengthened in this way. As the hole in the tube sheet is tapered and the

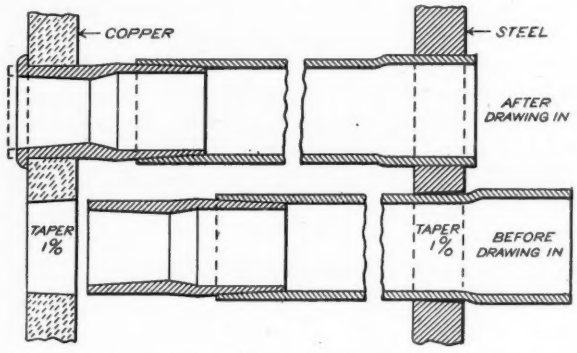


FIG. 3. TUBE USED ON BAVARIAN STATE R. R.

end is beaded over, the other end of the tube, the front end, is simply rolled.—The Boiler Maker.

THE MECHANICAL AND ELECTRICAL ENGINEERING LABORATORY OF OHIO STATE UNIVERSITY

THIS building which has just been completed and will be fully occupied by September, 1908, is of the modern shop construction with saw-tooth roof and is made up of 1 48 ft. and 7 30 ft. bays or divisions, which, with the enclosed galleries or rooms at the sides give a total width of 310 ft. The 30-ft. bays have a length of 112 ft. while the 48-ft. bay is 144 ft. long.

The enclosed galleries with spaces under them are for special laboratories, computing rooms, offices and the like. Each bay is abundantly lighted by glass occupying almost the whole area of the north slopes of the room, thus admitting only diffused light.

Next to this department is a small amphitheater for demonstration purpose, having a seating capacity of 120 persons. In this same section is the locomotive and automobile testing room 30 ft. wide by 70 ft. long, to be devoted exclusively to the above line of work.

The next section, 48 ft. wide by 144 ft. long, is for boilers, gas producers, and gas engines. The equipment of this room will consist of 7 different types of boilers, as follows: One horizontal water tube with economizer; independent super heater; vertical water tube; horizontal return tubular with setting especially designed for high volatile coals; one locomotive type; one stationary locomotive type with return flues; one internal fired marine type with corrugated furnace and one cast-iron sectional boiler of the class used in low pressure steam heating. A complete outfit for induced and forced draft will be installed so that any boiler may be run under a variety of conditions. It is also expected to install different types of feed-water heaters. There will be all necessary equipment for carrying on complete fuel trials with boilers and gas producer, the natural advantages in this direction being excellent in view of a good supply of natural gas and the close proximity of the University to the great coal fields.

The Custodis chimney, 100 ft. high, is equipped on the outside with a safety ladder leading to an observation platform at the top, thereby facilitating experimental work, relating to draft, etc.

The main laboratory room, 90 by 112 ft., is made up of three sections—steam engineering, hydraulics, and general laboratory work. The steam engineering section, next to the boiler room, will contain a simple slide valve unit for valve testing work, a simple throttling governor engine, a simple automatic cutoff, a vertical tandem compound, a McEwen horizontal tandem compound, a vertical cross compound Buckeye, 13 and 26 by 16 in. direct connected to 2 18 in. centrifugal pumps, each having a capacity of 8000 gal. per min. against 40 ft. head and a cross compound Corliss engine with piston rods extended to air compressing cylinders, each engine having its own flywheel, the two coupled by means of a flange coupling, and the whole so arranged as to run under a variety of conditions. There will be surface, jet and barometric condensers.

The hydraulic section now contains eleven cisterns having capacities ranging from 4000 to 30,000 gal. with weirs above and connections below. In 1 cistern is a water tight well of sufficient depth to obtain lifts of 30 ft. In this well will be located the barometric condenser, thereby bringing the condenser head in view and in proximity to the source of exhaust steam supply. Each cistern has a 2-in. connection to an observation well where the gage glass columns and hook gages will be located.

For this section the apparatus will be a Knowles plunger pump, Worthington duplex tandem compound, a Blake cross compound, a steam turbine direct connected to a six-stage pump giving high pressures, a power pump, several different types of belt driven centrifugal pumps, a standpipe for orifice and nozzle experimentation, a standpipe connected to a turbine water wheel, three types of impulse wheels, hydraulic rams, hot air pumping engines and the like.

The third section is intended for apparatus pertaining to the transmission of power; to blowers and fans, oil testing, refrigeration, air compression, etc. For the present all the machines for the testing of materials will be located in this section, until the main structure for these departments is erected, containing the materials testing laboratory

GAS ENGINES AND PRODUCERS

DO GAS ENGINES NEED ENGINEERS?

WHAT CAN THEY DO FOR THE GAS ENGINE INDUSTRY?

By H. W. Jones

I HAVE asked the question;—I am going to present a few cases, each and every one a matter of record, show the results of several tests, and present my arguments as clearly as I can, and then can I not expect from engineers and makers of gas engines an answer that will be a benefit to all?

What Is an Engineer?

Webster's dictionary defines Engineer as one who manages engines, and though I may be wrong, yet my idea of an engineer is different. The best engineer I know spends most of his days and a great part of his nights in studying the smoke that goes up the chimney; somehow he keeps his engines in such perfect condition that they seemingly run themselves, and his engineroom is a thing of beauty. He has under his control (all electrically operated) ice machines, elevators, motors, lamps, vacuum cash tube system, ventilation of building (a large department store) and all water pipes, stands, closets and fire apparatus, including an immense stretch of sprinkler system.

FIG. 1. DIAGRAM FROM 25 H. P. ENGINE; IGNITION LATE FOR STARTING

Incidentally, on the side, he manages about 1,000 hp. of high-speed engines (direct connected to generators) and he also heats the building and, last but not least, this man's pay is according to what he saves, and the last time I had a talk with him he said to me: "Mr. Jones, I have no kick on my salary." He has saved on coal; he has saved on oil; he has saved on repairs; he has saved on help; he is an engineer.

And he is one of the best posted men on gas-engine engineering that I ever met outside of the gas engine industry, which knowledge now stands him well in hand, because his boilers are overloaded, they need some extra engines and he knew just what he needed and where to place them to do the most good. And he is enthusiastic enough to extend his experience and his knowledge for the benefit of his brother engineers.

I asked him where he got his information, and his answer was characteristic of the man: "Reading and observation." That was all he said, but don't you see it covered the ground? Experience is the great teacher, but just reading the experiences of others gives you experience that you can gain no other way. There is a bond of sympathy between engineers. Go and see some gas engines that are run by engineers and then put your observations to practical use for your employer's benefit, as well as your own advancement.

The Engineer a Manager

But let's get back to where I started from. Engineers are those who manage engines. An engineer then is a manager, and there are as many grades of managers as there are engineers; yet how can anyone manage poorly; if he does poorly, he is a mismanager. Then again, a man who mismanages his engine is—what? Well, I don't know what he is, but I know what he is not, and that is he is not an engineer.

Then it seems to me that the logical conclusion can only be that an engineer is one who rightly manages engines; hence, a gas engine engineer is one who rightly manages gas engines and, if there ever was any other kind of an engine that needs right management as much as does a gas engine, I have failed to see it or hear of it.

FIG. 2. DIAGRAM WITH IGNITER BREAKING WITH CRANK ON DEAD CENTER

Gas engines do not need attention half as much as they need management. It is not the amount of work put on the engine. It is the kind of work, and the strange part of it is, that a gas engine requires more brain work (misnamed common sense) than it does manual labor. A few moments careful thought and study is often better than a day's work; or, to make it plain, 15 seconds spent in throwing in the igniter switch is better than four helpers pulling at the flywheel. Five dollars spent for a pocket voltmeter is better than a 2 days' shut down waiting for renewals for battery. A manager is pretty well prepared for emergencies, and a half dozen dry batteries

carefully put away in a good get-at-able place, has often been the means of saving a whole month's pay of the engineer who was thoughtful enough to put them there.

Now, the cost of the power is entirely secondary to the power itself;—first, power;—second, cost. And, an engineer should be and will be, too, when the gas engine comes into its own, engineer, first—cost of him, second.

But first engineer: He who rightly manages engines. The modern engineer, to go back again to

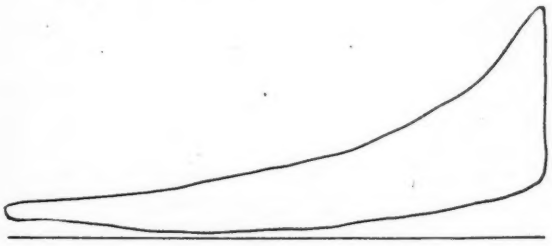


FIG. 3. ACTION WITH IGNITION WITH CRANK 25 DEG. AHEAD OF CENTER

the start, must be a fireman, electrician, machinist, ice machinist, elevator man, must have an insight into gas fitting, plumbing and must by necessity be a diplomat, and now along we come,—we internal combustion fellows with the news for you that you must be also a gas engine engineer, and right here is where you must show the goods. Here is where your engineering skill is needed, aye, demanded, and pay heed to this, be prepared.

The world today demands men who do things, men who make things go and keep them going. And I say, as one who knows, that it is harder to get a gas engine engineer than any other kind I know of. Not only one who can make things go and keep them going, but one who can do both right. A license to run an engine does not make the person to whom it is granted an engineer, yet I have heard it said that all it requires to run a gas engine is common sense. Don't you ever believe this.

You may have all kinds of common sense, yet you could not mix a primary battery, or wire up one. Common sense is necessary, and to be a good gas engine engineer it is absolutely imperative, but you need something else,—experience; and you need something else, engineering ability; and the more engineering ability you have the better for the engine, regardless of its kind. And whenever a man who runs an engine gets the idea into his head that an engineer is one who only runs an engine, that man has ceased to be an engineer, or else he never was one. An engineer sees to it that no useless work is done; that there is no waste; that the coal that goes into the firepot is all burned; and, that the heat from this burning coal is utilized, and so on, way down to the smallest detail. And, after all these details have been attended to the engineer opens the throttle and the engine runs all right. It's the little things that count in a steam plant, and it's the same thing in a gas engine.

How to Manage

This article is written for steam engineers. Some of you are prejudiced, and I want to give you one side that I am positive you have never considered. Gas engines do not need engineers; neither do steam engines. What both need is managers.

In order to get results that are right, a gas engine, (let us take for an illustration an illuminating gas engine) requires the gas, irrespective whether it is good or poor, and needs it in the right volume. A manager will see that it gets this volume. Gas engines need the right compression for the gas that you use. A manager will first put on an indicator to see what he has in his clearance, and then he will study up on his gas, and will arrange his engine to properly utilize all its power-giving properties.

He will adjust his engine, and it takes something besides common sense to properly adjust gas engines. He will see that the igniters and the igniting devices are rightly set for his conditions. He will see that the exhaust is clear, not only has free opening, but that no burning oil, no excess of fuel is thrown away,

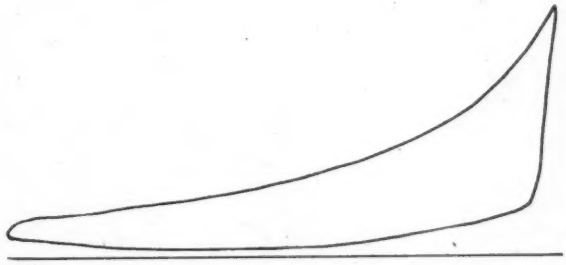


FIG. 4. DIAGRAM WITH IGNITER SET FOR 30 DEG. BEFORE DEAD CENTER

and not be satisfied with fair, but use his engineering skill to get everything as perfect as it is possible to have it. He will see that the line shaft is in line. He will see that every belt that is running is returning something for the power it takes and the wear it is receiving. He will see that all machinery under his charge is managed.

Do gas engines need engineers? Don't they need you? And yet, you seemingly sit idly by and see electric power installed and your job go when in your heart you know that you could install a gas engine and add your salary to the cost of running, and by your management of the machinery, make a good saving, and make the plant pay for itself. I do not claim that these places will pay as high as large plants, but I do claim that engineers, as a class, are men of brains, and gas engines need brains.

The writer of this article knows what he is talking about here. Look at the following cards, and these cards are real cards, taken by me in company

with several steam engineer converts to gas engine engineering, which is paying them big returns. My experience has been with about 30 different makes of engines. Under my personal supervision there are about 500 illuminating gas engines and 200 natural gas, from sizes of 1.5 h. p. to units of 125 h. p., pulling a load from a 10-gal. ice-cream freezer to an 85-kw. generator.

I have changed over to gas from gasoline about 35 engines, from producers 2, from kerosene 1, and have shown a saving in each case. But, when I make

FIG. 5. CARD FROM A 25 H. P. ENGINE AS FORMERLY RUN

this change and am supposed to show a saving I ask you, Do I tell the customer that he don't need an engineer? When a maker of gas engines is called on after the engine is set to make a brake test, does he say gas engines don't need engineers, or does he send out the best man obtainable to make this test? And the beauty of all this is, that a gas engine managed rightly will take up so little of an engineer's time that he can make a great showing on other machinery that will add to the saving, and his salary will be paid according to his ability. The doors are open to all; enter while you may.

Examples of Saving

A 25-hp. gas engine in an iron-working shop, pulling 18 hp. average, and it is no exaggeration when I say that 10 hp. is in friction in shafts and belts. There is no engineer, but there is a man who

FIG. 6. CARD WITH LESS FUEL AND EARLIER IGNITION

starts and stops the engine. On first examination we found the intake valve leaking so much that the engine was getting so low a compression that the power was cut down 30 per cent; that is, the engine would not pull a load of 18 hp. This leak was fixed. Then for the test. The first diagram shown is with 200-lb. spring, which was used on all. Note the compression. It should be at least 95 to 100 lb. Of course, the gas bills are small in amount, but it's not the amount alone but the principle. I'm not objecting to this to help engineers, but to help gas engines. Do you see the change coming? Real gas engine makers now never say their engines don't need engineers. They issue books of instructions addressed to engineers.

Figure 1 shows the ingniter breaking 10 deg. past center, as the attendant said that it started easier. It was advanced for running so that the igniter was breaking on dead center and was run continually in this way, as in Fig. 2. With igniter breaking 25 deg. ahead of center, Fig. 3 was obtained; during these 3 tests the gas valve was left just as it was when we first started the engine. Then we advanced the spark to 30 deg. ahead and Fig. 4 was the result. This was too early, don't you see; so we set it back again to 25 deg. ahead. Note, please, the exhaust and the back pressure; the engine has an auxiliary exhaust, which, note also, makes no showing on the card, this auxiliary exhaust being stopped up by carbonized oil, etc. The difference in the gas bill was $18.10 the first month. But was it only the engine? No! The whole shop was run just as was this engine,—without an engineer.

By moving two lines of shafting and changing the

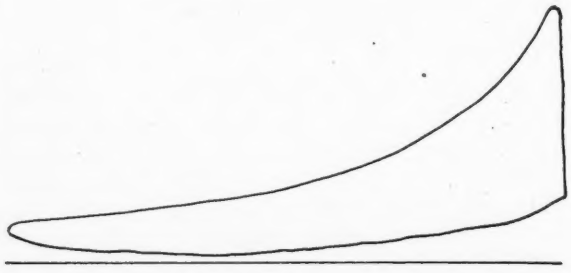


FIG. 7. CARD AFTER FINAL ADJUSTMENT

location of 1 machine, they would save 5 hp. in friction load, and this has been run just like this for 38 months, gas power costing about $4 per horsepower, or a saving of $760, if they would get an engineer. The cost of moving shafts, etc., would be less than $25, and yet it is not done. Do they, I ask, need an engineer?

An automobile garage has a 25-hp. engine, which was pulling on an average 12 hp. 15 hours a day. This firm has the best automobile (gasoline) expert that I know, and yet he ran his engine for 2 years with a showing like Fig. 5, igniting 3 deg. ahead of center, and this, although we took about 20 cards with the engine as they ran it, this was the best card we got.

By cutting off the graduated scale cock from 0.75, opening to 0.25, opening and advancing the spark to 22 deg. ahead of center, we got Fig. 6, and showed a saving of just 1 cu. ft. a minute.

This did not accomplish the results we set out to get. Being a hit and miss engine, it took too many charges to suit us, so we opened the gas valve to 0.5 and left the igniter at 22 deg. ahead, and we got Fig. 7, and by meter reading showed a saving of 90 cu. ft. an hour. The following month the gas bill dropped about $32. They are going to readjust their exhaust pipe also and a further reduction will follow,

I am sure. They are, as I say, expert automobile men, but they are not engineers. A good engineer, a real engineer, could save his salary of $100 a month in this place, but they can't see it now.

Do you think these are isolated cases? I could tell of 20 more that come under this same heading. Producer engines? yes, I'm in touch with a few. Do they need engineers? They need 2 of them; one is a gas engine engineer and the other is a gas engineer, and if these 2 are 1—and they can and will be—we certainly need them.

Steam engineers, there are none so blind as those who won't see. You have the knowledge, the experience, the ability, but do you lack the most essential thing needed for gas engine engineers; to-wit, common sense? Can I close by asking this question: Who are going to be engineers of those engines now going into the steel works at Gary, Indiana?

IN CASE OF FOAMING close the throttle and keep closed long enough to show true level of water.

A VERTICAL 4-STROKE CYCLE GAS ENGINE

Of greatest interest to power users at the present time is the cost of production and reliability of power. To these ends the gas engine has been successfully introduced as a competitor with other prime movers, and when its principles are understood its opponents become its supporters.

One of the foremost in this class of machines is the Bruce-Meriam-Abbott engine, which is of the vertical type, 2 entirely different styles being built, one to operate on natural or illuminating gas, and the other to operate on producer gas.

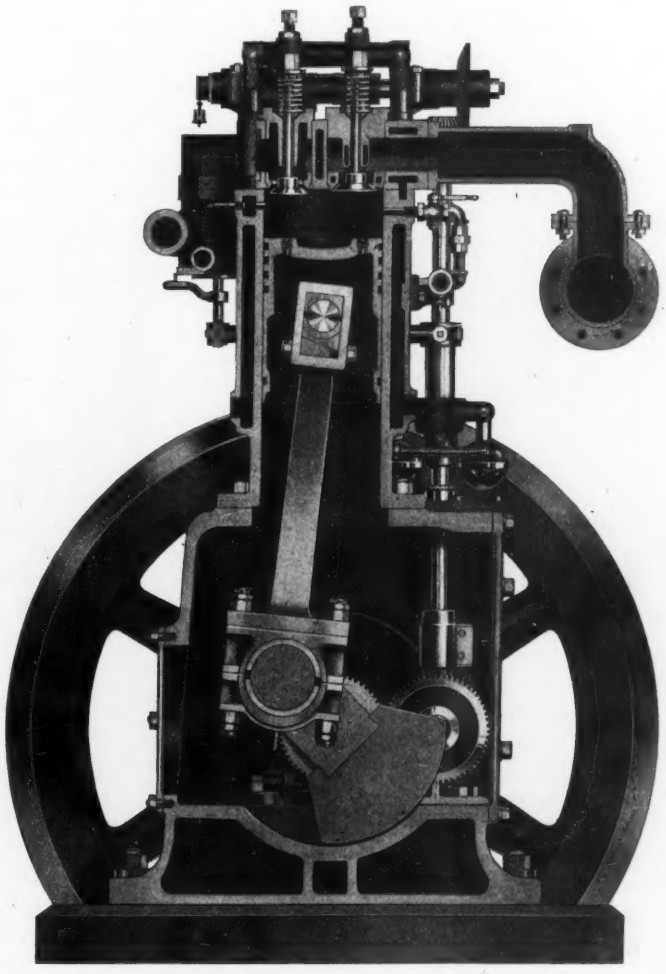


FIG. I. CROSS SECTION OF BRUCE-MERIAM-ABBOTT ENGINE THROUGH CYLINDERS

The engine is of the multiple cylinder vertical type using the 4-stroke cycle, giving periods of admission, compression, explosion, expansion and exhaust, as follows:

On the first downward stroke the gas and air pass through the mixing chamber and enter the cylinders. The return stroke, or the second one, is upward, which compresses the mixture, at which time the charge is ignited by an electric spark when the piston makes its downward or third stroke during the expansion

and explosion of the gases. On the upward or fourth stroke the exhaust valves open, allowing the burnt gases to escape through the exhaust chamber to the muffler and exhaust pipe to air.

One advantage of the 4-stroke cycle is the positive expulsion of the burnt gases. The governing is by means of a throttling governor, which results in the engine taking the mixture of gas and air in in varying quality which is proportioned according to the nature of the gas used at the start, and remains unchanged for all loads.

It is a recognized fact that the higher the compression the greater the efficiency, and this is limited by the increased weight of parts required to withstand the increased pressure. The engine under consideration is well proportioned to withstand the heavy pressures, resulting in long life and noiseless operation.

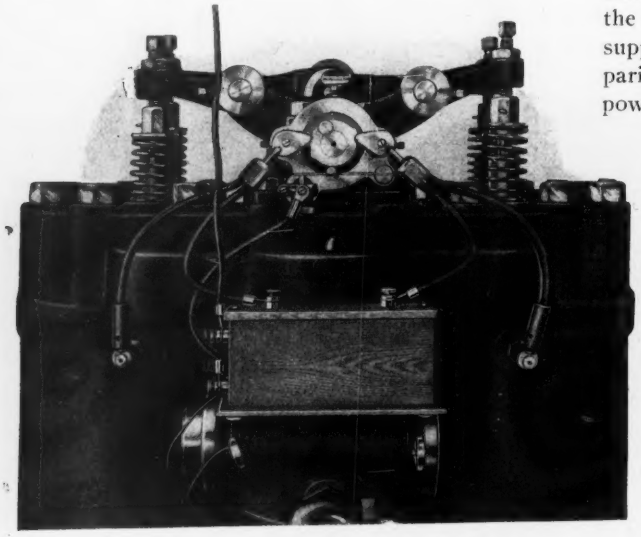


FIG. 2. IGNITION DEVICE ON VERTICAL CYLINDERS

Explosion takes place alternately in each cylinder by an arrangement of the cams and sparking mechanism, giving an impulse to the crank every revolution in the 2-cylinder type and every stroke, both upward and downward, in the 4-cylinder type. These engines, being vertical, are compact, and are capable of operating at high speed, being especially adapted for direct connection to generators.

These engines are made by the Bruce-Meriam-Abbott Co., of Cleveland, O.

ANALYSIS OF THE WATER in the Great Lakes by the U. S. Geological Survey shows that 3,350,000 lb. of dissolved minerals pass out of Lake Ontario each year, of which 441,000 lb. come from Lake Superior, 666,000 lb. from Lake Michigan, 913,000 lb. from Lake Huron, 840,000 lb. from Lake Erie, and 490,000 lb. from Lake Ontario. These figures seem large, but the amounts are so small a percentage of the water passing that the lake waters are excellent for boilers.

THE RENTAL VALUE OF A POWER PLANT

BY CHARLES T. MAIN

The rental value of a power plant depends upon its character and efficiency to produce power cheaply.

The cost of producing power in small amounts is very much greater than in large amounts, and the amount which the lessee should pay may be obtained in comparison with the cost of producing the amount of power required with a reasonably efficient plant with steam power or by some other means. Thus, suppose that the power to be rented is water power and plant, its value can be determined by estimating the cost of producing a uniform power by water power, supplemented by steam power, if necessary, and comparing the cost of producing the same amount of power by steam power alone, in each case adding such charges as the lessee is to assume. The difference, if in favor of the water power, will represent the value of the power for the length of time the estimated cost covered.

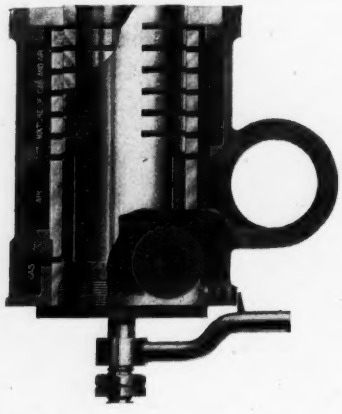


FIG. 3. SECTION OF MIXING VALVE

If the power plant be a steam plant, it is possible that it has no rental value; that is, it may be so wasteful that it would pay to replace or change parts of it to bring it into an economical state. If it is an economical plant, and is to be run by the lessee, he should pay such rent as will cover depreciation and a fair rate of interest, and assume repairs, insurance, and taxes, or pay enough rent to cover them.

In the same way, if power is sold to the lessee, the proper amount to pay a horsepower a year will vary with the amount which he requires.

As the amounts of power grow smaller, the relative cost of producing it is larger, and therefore, a larger price per horsepower per year must be paid.

The charges for small amounts of power seem to vary from $50 to $100 a horsepower a year; but each case should receive its careful attention.

THE MOST VALUABLE GASEOUS FUEL is the natural gas of Pennsylvania and Ohio, the calorific power being about 900 B. t. u. per cubic foot.

THE AMMONIA COMPRESSION SYSTEM*

By George Norden

WHAT is known as the compression or high-pressure side of a compression system, consists of the ammonia compressor, condenser, receiver and oil separator. The machine or pump is composed of reciprocating parts, purely mechanical in their action, operated on principles well known to the engineer in charge.

To accomplish the same result the modern absorption plant comprises the following: Generator or retort with coils; analyzer or drying chamber with baffle trays; exchanger or heater with coils; ammonia condenser; weak liquor cooler with coils; absorber with coils; ammonia pump and ammonia receiver.

Here you have a number of inaccessible and complicated parts, unreliable and depending entirely on the action of a mixture of water and ammonia, which, at times, is peculiar, under the conditions of its use in the various parts. You can readily see with so many closed vessels, coils, etc., the chances of leakage are many and as the aqua ammonia has a corrosive effect on the material it comes in contact with, the cost of repairs and maintenance is an important consideration, when comparing the absorption and the compression systems.

As to cost of operating, it has always been a claim of the compression advocates, and I believe this can be substantiated, that an absorption plant requires not only low temperature water, but a quantity of it largely in excess of the amount required by a compression plant. We are given to understand by the builders of absorption machinery that their plants of modern construction require no more water for cooling and condensing purposes than compression plants. This, they claim, has been accomplished by the use of double-pipe ammonia condensers in place of the submerged type and of double-pipe coolers for re-using the absorber water. This adds to their equipment a couple more parts, more or less inaccessible.

For condensing the ammonia in either case, the amount of water required is the same, but an absorption plant has the advantage of requiring additional water for extracting the heat generated in the absorber and the poor liquor cooler.

Now as to steam economy: On a can ice making plant using distilled water, there is practically no difference in the amount of steam required. On a refrigerating compression machine driven by a simple Corliss engine, the steam consumption is favorable to the absorption machine, but when a compound condensing engine is used, the amount of steam required is in favor of the compression machine. Even with a simple Corliss engine the compression machine can be operated with somewhat greater economy than is customary, as it has been shown by recent tests that the speed at which a refrigerating machine is operated affects the horsepower required to drive the compressors. The higher the speed, up to a reasonable limit, the less will be the horsepower per ton of refrigeration. The limit of such speed is up to a point where the valves will work properly.

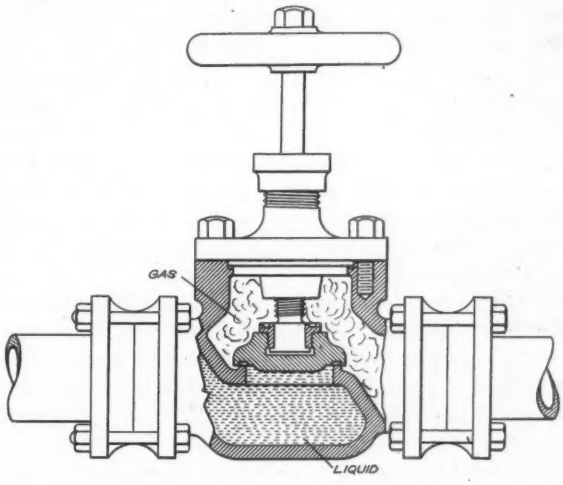
For simplicity and economy, or cost of producing ice, on the can system, the compression machine using ammonia as a refrigerant, is the best system. The failure or success of such a plant to obtain desired results depends largely on its parts being properly designed. The proportions should be studied out by engineers of expereince and the manufacturer should not be asked to incorporate in his specifications and to furnish apparatus contrary to his standards, or what he considers best for the purpose, as he usually is called upon to guarantee a certain capacity.

*Abstract of a paper read before the Western Ice Manufacturers' Association.

SETTING THE EXPANSION VALVE

By Ben T. Edwards

NO HARD and fast rule can be laid down for setting an expansion valve. The accompanying cut will give some idea of the valve in operation. The disk is raised off its seat slightly, so that the liquid in being forced through the small opening is vaporized. The line where the expansion from liquid to vapor takes place should be the beginning of the frost line.



ACTION OF THE EXPANSION VALVE

In setting the valve, dampen the finger and press upon the valve and pipe until it sticks or freezes the moisture upon the finger. Too wide an opening will allow the liquid to pass through without evaporating; experiment only can establish rules for each particular instance.

In the case of a direct expansion system, the changing of one expansion valve may affect the working of valves on other coils in the system by taking from

or adding to the pressure as the case may be. The passage of unevaporated liquid may sometimes be detected by the ear. A close observation of the thermometer as well as the condition of the coils in the coiling room, will soon enable the operator to set expansion valves to the best advantage for his needs.

LOCATING A CLICK IN THE VALVES

By F. E. Matthews

IN A 9 by 18-in. double-acting De La Vergne Ammonia Compressor there was a decided click when passing crank end center. Apparently this came from the head end discharge valve. The outside of that valve chamber seemed warmer than the one for the opposite end; also the suction valve cap for that end would not frost over as well as the one on the other end. The engineer reported the machine in good shape and that all valves had been recently gone over. The case seemed diffiicult to diagnose without hearing the click and watching the machine, but after consideration I reached the conclusion that, spite of the seeming, the trouble was in the head end discharge valve.

My reasons for thinking so are as follows:—The fact that the head-end suction valve did not frost over as well as the other one, indicated that there was less cold gas passing that valve. The most plausible reason for this condition was that either the one or the other of the valves on that end of the cylinder was not working properly. Now hot gas discharged from a compressor is considerably warmer than the atmosphere of the engine room so that, were there no hot gas passing through the discharge port at all, radiation would soon reduce the temperature of that valve bonnet to very nearly that of the engine room.

If this valve bonnet had been cooler than the other one, we would say that the head-end suction valve was stuck open and that the compressor was simply churning low-pressure gas in and out of the cylinder. Such a condition would soon melt the frost all off the suction valve bonnet, but the result would have been so marked that it would have caused special comment.

Since conditions did not seem to warrant the hypothesis that the head-end suction valve was stuck open we will examine the other immediate possibility, viz., that the head-end discharge valve was in trouble. In this event there would be a reduction in the amount of cold gas entering the cylinder which would account for the falling off of the frost. The condition would not be as marked as in the preceding case, however, and would undoubtedly be more in line with the statement that this valve "did not frost over as well" as the opposite one.

Now when a compressor is receiving cold and discharging hot gas regularly it is apparent that the discharge valve bonnets will be cooler than would be the case were the discharge valves to stick open so that instead of the cylinder receiving a complement of cold gas it simply churns the hot charge. Every time that the hot gas is brought in contact with the hot cylinder walls it absorbs more heat, until finally it becomes practically as hot as the compressor. Such a condition would give rise to the symptom mentioned, viz.: that "the outside of that valve chamber runs warmer than the other one."

Of course, the results described would be less marked if the trouble were not constant, as is usually the case. If, for example, the valve fails to work on an average of 1 time in 5, the compressor will be performing only 80 per cent as much work as it should, and the reduction of 20 per cent in the amount of cold gas being admitted to the cylinder would produce less marked results on the frosting of the valve bonnets than would be the case if the valve refused to work, say 50 per cent of the time. Since no mention was made of any trouble with the machine until new discharge valves were installed, we are more than ever convinced that the above explains the difficulty.

We might not be warranted in the assertion that this is a characteristic of new valves, yet the fact remains that, other things being equal, there is more opportunity for trouble with new than with old valves. This is principally because of their not having gotten worn down to a bearing and like a new bearing of any kind, increased friction due to their working stiff causes them to heat and stick. This is particularly true of discharge valves because of the fact that the light volatile oil necessarily employed in refrigerating machines is easily volatilized.

Regarding the click mentioned as occuring when the compressor passed crank center, it may possibly indicate distress in the discharge valve. Even then we should hardly expect it to occur exactly on the center or, in fact, to occur at exactly the same point every revolution. While we scarcely thing that the following is the explanation of the noise, we would suggest to take the clearance on the crank end, or what would be better, on both ends, and see that the piston is not running too close to the crank end head.

It may be that the presence of head pressure on the head end of the piston as the crank is passing crank center may be sufficient to allow the piston to strike the head, whereas the greater difference in pressure between the two sides of the piston when running normally, would prevent striking by keeping the backlash taken up until after the piston has left the end of stroke.

It is possible to relieve matters temporarily when this trouble occurs by jarring the discharge valve housing. If it can be previously cooled by the application of ice, it would probably assist matters somewhat. At the next opportunity to remove the discharge valve, it will probably be found that all further trouble can be eliminated by simply draw filing the valve stem where it appears to be binding tightest.

A PRESSURE REDUCING PIPE SYSTEM

The arrangement of piping, as shown in the sketch, has been in use for the last 5 years in our central heat and power plant with marked success. The object is to reduce the boiling pressure of 150 lb. to 40 and 5 lb., respectively, without the excessive wear and cutting of ordinary valves, which always result from this practise.

To avoid this wear on the valves, I have introduced what might be called reducing tubes. These are of cast iron 15 in. long, and are shown in detail in Fig.

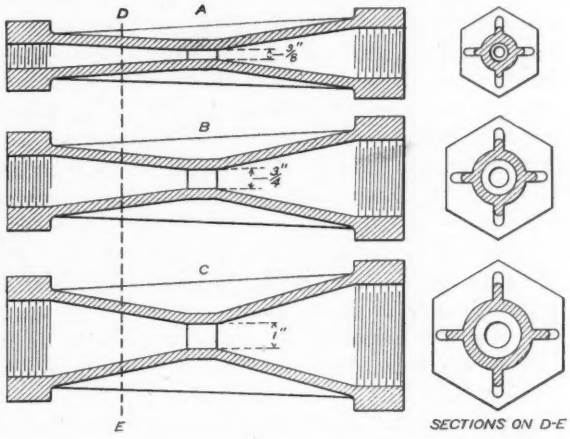


FIG. 1. THE REDUCING TUBES IN SECTION

1 as A, B, and C, and their position in the pipe system is also indicated as A, B and C, Fig. 2.

The operation is as follows: The supply of steam necessary for the 10-in. and 6-in. heat lines is by no means constant. The demand can, therefore, be supplied by either the 1-in., 2-in., or 3-in. lines, but upon opening, for example, the 1-in. valve, the steam is first greatly reduced in the tube, which, of course, transfers the wear from the valve to the tube. As these tubes are almost indestructible, the saving in valves and disks is no small item.

In case the boiler pressure is low, say 60 lb., such a condition as we have on Sunday, the 6-in. valve can, of course, be used. And, if the pressure should increase, the pop safety gives ample warning.

The 10-in. line is simply an exhaust heating line, and the tubes and live steam pipes, as shown, are merely used as a makeup when the exhaust steam is not sufficient.

Since installing this tube method of reducing pressures, I have observed many places where it could be used to advantage, especially as an auxiliary to a reducing valve. If one had a constant boiler pressure and reduced to a certain lower pressure with a somewhat regular demand it would be possible to proportion and use such a tube in place of a reducing valve.

Arthur Dufty.

RECHARGING DRY CELLS

The question is often raised of recharging a dry cell, and it has usually been answered discouragingly and the operation classed as absurd. A method of rejuvenation used by Prof. Woodworth, of Lewis Institute, is to convert them into wet cells by punching holes in the zinc cup and setting the cell into a dish of water.

When used for igniter circuits on gas engines, the cells sometimes run down, and methods of recharging have been found successful as follows: Run current from a dynamo back through the cells, the same as

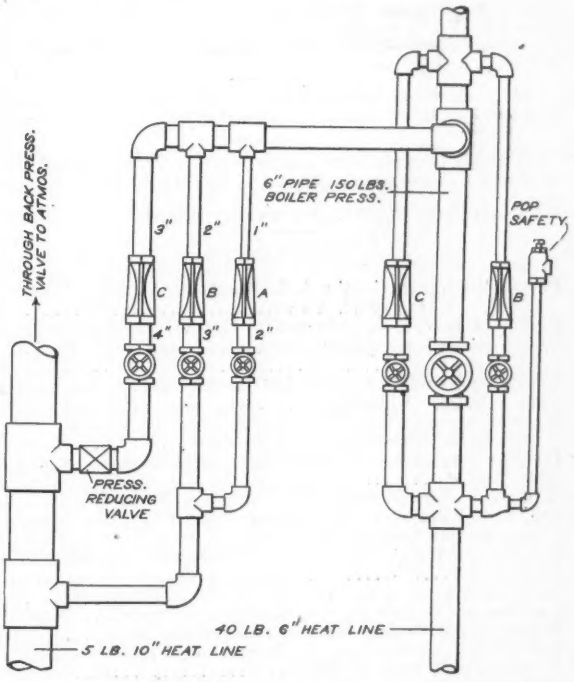


FIG. 2. ARRANGEMENT OF REDUCING TUBE SYSTEM

for a storage battery, the positive wire from the dynamo connecting to the carbon on the battery. The time of charging is short, one experimenter giving it as 15 minutes to bring a dead battery of 6 cells up to 9 volts and 14 amp. We are interested to hear what results our readers get from this method.

IN PLEASING CONTRAST to the policy of retrenchment being pursued by many of the railroads of the country, is action taken by the Chicago, St. Paul, Minneapolis & Omaha Railway to improve the equipment of its car-building and repair shops at St. Paul, Minn. To provide additional power now needed there the company has purchased an 18 by 28 by 306-in. tandem compound engine, to be direct connected to an electric generator of 300 k. w. capacity. This machine is now being built at the West Allis works of Allis-Chalmers Co., and will be installed in the very near future.

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THEORETICAL, TECHNICAL AND PRACTICAL

Much confusion is occasioned in discussions in societies and journals by the lack of clear understanding of the exact meaning of these terms, and much harm is done to the cause of engineering by the unnecessary disagreements between the so-called scientific and the so-called practical engineers, "scientific" here being used by the defender of that kind of engineering as meaning all that is correct, and by those who array themselves on the practical side as meaning all that is visionary and absurd.

As a matter of fact, if they are correct, theory, technic and practice must all agree. A man who works by correct scientific principles embodied in theoretical laws will be following the best technical practice, and the man who is really practical will be using in his work the known facts of science in a proper technical fashion. This last sentence has sufficiently jumbled theory and practice so that anyone who can straighten them out and separate them is welcome to do so, but it expresses a fact, nevertheless.

If we go to the definitions we find that theory is "An exposition of the abstract principles of a science or art considered apart from practice." Evidently the principles on which an art is based must tie up with the every-day facts which the practical man uses. If the theory gets so far apart from practice that it does not recognize facts, then it is no longer correct theory, and unfortunately some of our school-trained engineers have handled their theory on this basis, bringing disrepute on the term "theoretical."

"Technical" is defined as those branches of learning which relate to the arts; in other words, the term technical refers to such knowledge as applies directly to doing things. It is, therefore, the learning on which practice depends and may be acquired either from books and periodicals or from working with other men. If the directions are correct it makes little difference whether the man learns to set the valves of a Corliss engine from studying a book or from being shown by another man. The condition in either case must be that the one who is teaching knows what he is about.

"Practical" means useful, capable of applying knowledge or theory to practice. The practical man is not, therefore, the man who knows only those things which he has learned from his daily work, but is the man who can take theory and technical information derived from any source whatever and apply them to useful ends. He is the man who is of greatest value in doing the world's work, but the man who holds the idea that theory or technical information are opposed to or in some way injurious to practical ability has simply got his ideas mixed.

If a man starts off with the notion that he knows it all, whether he has received his training from school or from shop, he is likely to make several and serious blunders. If the book-trained man refuses to learn

from the experience of the shop, his plans will generally go wrong. If the shop-trained man refuses to learn what he may from books and journals, or even from the school-trained men whom he meets, he cannot go far because his progress must stop with the knowledge that he can gain in his daily work, and one man's experience is necessarily very limited.

Unfortunately, among operating engineers there is a great tendency to shy at anything which looks like a formula. To be sure, intricate formulas are usually unnecessary in operating machinery, but it is impossible to make any large progress in the understanding of electrical machinery in particular without the ability to use the simpler formulas of algebra and trignometry. The fear which is entertained of these two names is a good deal like the child's fear of the bogie man—without foundation or reason.

The unfortunate part of the proposition is that most books on algebra and trignometry have been written without any regard to the needs of the man in the shop. The object in preparing them has been either purely mental gymnastics or a course leading to design, which involved complicated and difficult mathematics.

The application of the simple principles to shop and power plant problems has, therefore, been neglected. As an instance, there have been a number of books published called Arithmetic of Electricity, and Arithmetic for Engineers, but so far nothing on Algebra for Engineers or Trignometry for the Machine Shop, although these two sciences are used in their application every day by any man who has to do with machinery, and are great time savers if they are once mastered.

Probably the reader who has had the patience to wade through this dissertation is wondering the whyfore of the talkfest. Simply this: The most practical man is he who brings to his aid all the information he can get in doing his work, who knows the real reasons behind things he does, and who gets all the technical information he can, whether it be so-called theoretical or so-called practical; and the man who wants to progress must remember that he can get practical help from a knowledge of the elements of mathematics above arithmetic which are easily within the range of his comprehension if he will but put a little time and effort upon them.

FALL BUSINESS

Why any hesitation about pushing business? A dollar made in July is as good as one made in October. If you are of those who wait on the crops, the reports are all favorable, for the government predicts a clear hundred million bushels more of wheat than in 1907 and three hundred million bushels more of oats. This means good times and plenty of money in the farming districts and centers of trade.

On top of this comes the news of a reduction in the price of steel of from $2 to $4 a ton by the leading manufacturing companies, which will give easier conditions for all lines of machine making and an impetus to building of railroads, public works and private plants.

It is practically settled who will be the opposing candidates in the presidential contest, and although we all have preferences, it is practically certain that there will be no great overturn of present policies whichever way the election goes.

Everyone is looking for a resumption of business activity in the fall. Why wait? The way to resume is to resume, and those who push now for business will get their share sooner and larger than those who wait. The Prosperity Association, whose members agreed to start up factories June 1 and do business, has gone a long way toward bringing prosperity, and here's wishing them the success they deserve and will get.

FOURTH OF JULY

One hundred and thirty-two years ago the forefathers of us great and noble Americans declared that they were no longer subject to be spanked by Great Britain, and to prove it, went out, "fit, bled and died." We, therefore, as loyal citizens, consider it necessary to blow up, bleed and die in order to show that we appreciate what they did for us. It is easily understandable why the excitement of the time should have caused the men and boys of 1776 and thereabouts to throw up their hats, ring the bells and fire off their guns. Probably they had as much enthusiasm and tendency to yell as the modern American, and there was no baseball game over which to let off their steam; but why on earth should we now turn these United States into a national hospital for the rest of the month in order to signify that the Fourth of July has come and gone?

The small boy evidently is born with more noise than his system can stand, and must have a safety valve or explode, but if it comes to a case of keeping the noise in and letting him explode, that might be as good a proposition as letting him set off cannon crackers and blow up everybody else. If he must have a tin horn, give it to him, or some other harmless method of making the day a source of torment to the community, without endangering himself or his neighbors. Then let us burn gun powder in the form of fireworks in the evening under the control of some sane and careful body of men who will see that they are used to increase the pleasure of the community and not to make work for the fire department.

There is as much sense in firing off a cannon at the imminent risk of half the city block or of the entire town or village collected on the public square as there would be in tying down the safety valve, building a rousing fire and blowing up a boiler in order to celebrate the fact that the Chinese New Year had come, and it is just about as civilized a proposition. Perhaps the elimination of the firecracker is too much to hope for, but engineers are extremely interested in the passage of license laws to secure the public safety;

WIRING AN ELECTRIC SYSTEM FOR ECONOMY

By C. R. McGahey

A GOOD lighting system, poorly operated, is often found in many of our Southern cities, where the best equipment is used so far as the power house goes, but where the distribution system is poor, to say the least. This especially applies to the multiphase systems. It is no uncommon sight to go into a small town, where the single phase system has been installed and which has been later changed to a three-phase system. One plant in particular has a three-phase plant, with one of the phases not working, and yet the best apparatus that could be had was installed in the plant, and modern transformers could be found on the street, changing the two-wire to three-wire distribution.

There is no system that has so many points of value as the three-wire distribution. When carried out properly, it will give perfect regulation and a high efficiency lamp can be used. If the regulation on a system is poor, we must resort to a high wattage lamp. It is our only hope. For example, on this three-phase system in question, which is running two-phase, the drop in the lines to the center of the city was enormous. Even at a voltage of 2300, a drop of 10 volts was the average during the heavy load period, so it can be seen at a glance that the voltage, being controlled at the switchboard, as is common in these small plants, would cause the lights to be very poor in the center of the city when the heavy load period was on. Now by having this three-phase generator and by running it on the third phase, this loss was picked up and a much better voltage maintained on the center of the heavy load distribution; but even at this, it was not the best, as the load was only balanced across the phase by the two-wire transformers, and long secondary runs were used. All this loss on the secondary could have been changed. For instance, the secondary leads were carrying, say, 110 volts, and the same transformers could be used on a three-wire secondary distribution with 220 volts across the outside, giving a greater carrying capacity of the present copper with but little expense, and by wiring the buildings on a three-wire system, where a large amount of current is used, you would get a perfect balance, and consequently a perfect regulation.

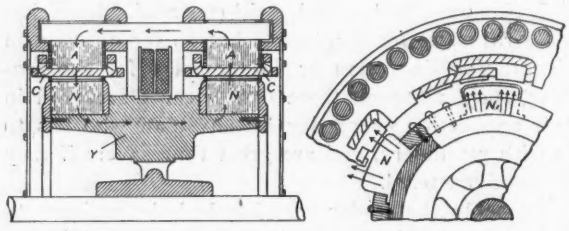
The word regulation, when used here, does not apply to the governor of the engine, but applies to regulation of the wiring system. The wiring should be in such a shape that the voltage will rise and fall on the entire system alike. You will then have a system of good regulation, and if properly run from the power house, you can use the low voltage lamp that is now on the market.

In some plants, lamps approaching 4 watts per candlepower are used, which means for a 16 c.-p. lamp, $16 \times 4 = 64$ watts, or for 10 lamps, a total wattage of 640, or 100 watts short of 1 hp. It is not as uncommon as some may think to find this kind of a lamp on a circuit, and many engineers are burning more of this kind of lamp than they think. A common figure is 3.5 watts or 56 watts per lamp, and with this lamp, 13 lamps with 18 watts over can be used per horsepower. Using the 3-watt lamp, 15 lamps with 26 watts surplus can be used per horsepower, all of which is power gained by the central station. Of course, we must have a good regulation, and this must be obtained by putting the wiring in shape as well as the powerhouse.

In many small plants, where there are overloads, the load can be cut down at the powerhouse by having the proper distributing system, which means less coal bills and increased dividends.

S. K. C. INDUCTOR ALTERNATOR ACTION

S. K. C. refers to the trade name of the system, which was the Stanley-Kelly-Chesney system, the apparatus for which was made by the former Stanley Electric Co. In this machine a coil of wire which is stationary surrounds the moving part and magnetizes this part. On this moving part are projections or pole pieces and on the stationary ring are an equal number of projections.



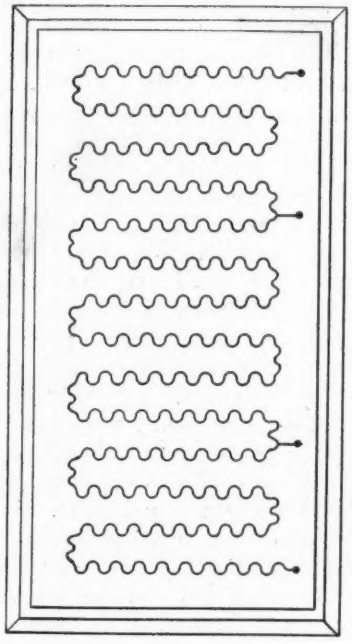
SECTION OF S. K. C. INDUCTOR ALTERNATOR

When the projections are opposite each other, the magnetism flowing through the moving and stationary parts is high. When the projections on the moving piece are opposite the gaps in the stationary piece, the magnetism is very much lower. On the stationary projections are wound the armature coils for the machine, and it is the variation in the amount of flux or magnetism, from practically nothing up to a maximum amount which generates electromotive force and, therefore, current in the armature coils.

In the illustration herewith, Y is the moving part having projections N and N. The coil which carries magnetizing current is in the center and the projections from the stationary part are A A. The magnetism flows through the stationary and moving parts as shown by the arrows on the figure. When the projections N and N are directly under a pair of the armature coils, the magnetic flux is large. When these projections pass on, the magnetic flux becomes small and thus an electromotive force is set up. Y is the moving element and this has no connections or wire winding upon it. It is really the field core.

REPAIRING A RHEOSTAT

The following is an account of how a Rheostat was repaired at the place where I am employed: One morning one of the plates of the rheostat burned out, and as it was necessary to have it repaired in a short time, it was up to the chief engineer. He secured a hard wood board, 1 in. thick, 11 in. wide and 26 in. long, and covered it with asbestos. Then he got a strip of German silver, placed it on the board, as shown in the drawing, took the other one down and put this one up in its place. This has been in operation for more than 6 months and has given satisfactory results.



NEW PLATE FOR RHEOSTAT

J. W. C.

RESISTANCE FOR TESTING A 230 K. W. DYNAMO

For testing a dynamo for acceptance, difficulty sometimes arises in disposing of the power generated. A water rheostat is often the simplest solution, but this is irregular in its action and where it is important to hold the load steady, a device described by T. Robson Charlton in The Engineer-in-Charge, has advantages.

Hoop iron 1.5 by 0.056 in. and 220 ft. long was bent into grids and fastened to a wood frame. At each end was a copper bar with a hole in it for bolting the terminal sleeve to a cable and on the other end of the cable was a tee connection for fastening to the mains. The grid was put into a tank 10 by 20 ft. and 1 ft. deep, into which water was run continuously to cool the iron.

This resistance carried 875 amp. at 220 volts, the water temperature being 68 deg. F. when starting and 135 deg. after 1.25 hr. run. The water was continually stirred with a paddle, but this length of run was about all that could be carried.

The watts disposed of per square inch of iron surface were 24.3 and the amperes carried per square inch of cross section were 10,417.

MAKING FORCED AND SHRINKAGE FITS

To bore and turn forced fits and to drive fits is a frequent occurence in all first class shops where engine work is done, and it is quite important that engineers should know how to make one if necessary.

The first step in making a forced fit, is to caliper the hole or shaft to be fitted, very closely. Next, figure the amount necessary to set the micrometer. A good rule is to allow 0.002 in. per in. of diameter; for instance, for a 6 in. shaft, 6×0.002 in. $= 0.012$ in. To find the tonnage required to press the fit, multiply the diameter by the length and by 1½. For instance, if the above shaft fits for a length of 12 inches, the tonnage required for pressing the fit would be $12 \times 6 \times 1\frac{1}{2} = 108$ tons. A machinist knows that very large fits and extreme lengths do not require so much allowance as small shafts, because the tonnage required would be very large. For example, a 20 in. fit, 40 in. long, would require $20 \times 0.002 = 0.04$ in. difference, and a pressure of $40 \times 20 \times 1\frac{1}{2} = 1{,}200$ tons. Few large shops are equipped to handle that amount of pressure; in fact they do not need that amount. In fitting large pieces like the above, a clearance of 0.012 in. would give ample tonnage and for a 4 in. car axle, a fit of 0.008 in. will give a 40 to 45-ton fit. A hand-reamed hole gives better results than a bored hole.

If the tonnage and size of shaft are given, the clearance required in thousandths of an inch can be obtained by multiplying the diameter by 1½ and dividing the tons pressure by the product; for instance, if a 6-inch shaft must be driven in with 45 tons pressure, $6 \times 1\frac{1}{2} = 9$ and $45 \div 9 = 5$ thousandths of an inch. Another rule allows 0.002 in. up to 2 in. diameter, and over that 0.003 in., using judgment as to the length of space to be fitted.

In the case of a drive wheel that has been pressed off another shaft to be refitted, one-half of the above rule will give the same result, as the iron has been hardened by being forced together by the former fit.

Shrinkage fits are not made so accurately in most cases, and are used where great binding power is necessary, such as is required for disk cranks, piston heads and locomotive tires. Some railroads use 1/64 in. to the foot of diameter, others use 1/32 in. per foot, but in most cases 0.003 in. for the maximum and 0.002 in. minimum per inch of diameter will give good results.

NEW SHOPS OF THE GREEN ENGINEERING CO.

A MODERN PLANT FOR THE MANUFACTURE OF CHAIN GRATE STOKERS

THE disadantages of the several methods of hand firing and poor economy obtained, have led to the development of the mechanical stoker.

By the utilization of stokers the boiler efficiency is greatly increased, smokeless combustion obtained, the severe expansion and contraction strains minimized, all with the minimum of labor, attention and repairs.

A finely equipped and modern plant devoted to the building of a successful and improved stoker is that of the Green Engineering Co., at East Chicago, Ind. (Calumet).

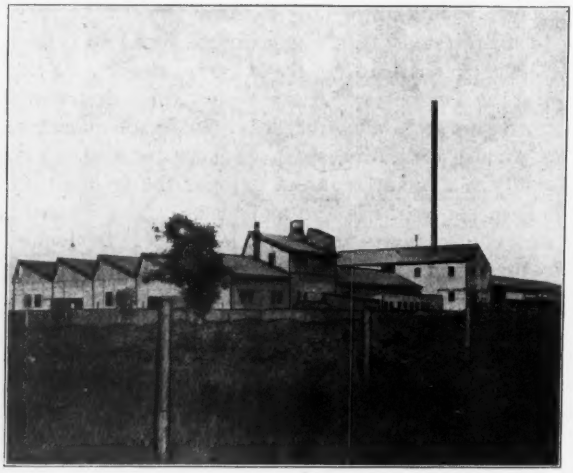


FIG. I. GENERAL VIEW OF THE GREEN ENGINEERING CO. PLANT

Buildings

The site when purchased was swampy and sandy, containing about 10 acres. To secure a good foundation, Joseph Harrington, general superintendent, decided to excavate until a substantial surface was secured, on which a solid concrete bottom was built.

Trenches about 3 ft. wide were dug, into which channel beams were set vertically, 20 ft. apart, the remainder of the trench being filled with concrete up to about 4 ft. below the ground line, when a layer of cinders was spread, on which the railroad tracks, which run on the east and west sides, were laid.

The vertical channels were set in pairs and tied together to form lattice columns. At the top and bottom 6-in. I beams were run to act as sill and plate and also to tie together the 3-in. upright I beams, which were set between the columns to form 5-ft. panels. To these the plank used to form the moulds for the concrete wall panels were fastened. The roof is of saw tooth construction, affording excellent light. Trusses of T beams span the side bays and the center transfer bay, and book tile are laid on these. Fig. 1 gives an exterior view of the plant.

The buildings are divided into 3 bays. One on each side, where the various machines are located, and the central transfer bay, which runs the whole length of the plant, allowing castings to be taken from the foundry through to the warehouse if required.

Figure 2 gives the plan of the shops. At the north end the foundry is located. It is well ventilated and lighted, 100 ft. wide by 180 ft. long, and traversed in all directions by an electric crane of 3 tons capacity. This allows the large ladle to be carried easily to the molds for filling the usual small ladles.

On one side of the cupola is located the blower room, on the other side the core room; in the south end, the sand storage and cleaning room.

Separated by a passage, is the power plant, and pattern shop and storage, 2 separate buildings, 40 ft. wide by 46 ft. long.

South of these buildings is the machine shop, well lighted and airy, which is 50 ft. wide by 300 ft. long. On each side of the shop porches 23 ft. wide and extending the entire length are erected, and traversed by cranes of 2 tons capacity, making the loading and unloading of cars easy and quick.

Continuing to the south, the warehouse is located, where complete stoker parts are kept.

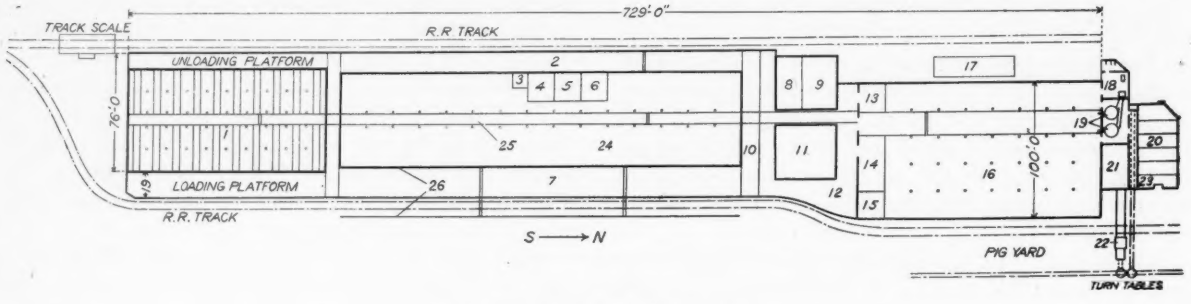


FIG. 2. PLAN OF THE SHOPS

Handling the Work

The patterns coming from the pattern shop or storage, 11, Fig. 2, pass into the foundry. The cupola, which is a Whiting, has a capacity of 10 tons an hour.

Molding machines are used entirely in making small castings, which secures uniformity and interchangeability of parts. The company has selected the Oregon machine as best suited to its needs, and has about 50 in use.

Castings not required for immediate use are carried by the crane to the proper bins on the west porch, from which they are brought through suitable doors, as necessary, to their respective machines.

All steel and pipe are unloaded from cars to their proper places on the east porch for storage. When called for they are passed into a door in direct line

FIG. 3. NORTH END OF MACHINE SHOP, LOOKING SOUTH

with the saw, where they are cut to proper length. From here they pass direct to the various machines, such as drills, punches and lathes, all parts meeting in the center transfer bay, where an electric crane carries them to the erecting floor, which takes up the entire south end of machine shop, or to the warehouse. Cranes travel over the shop, and it is a rule with the management never to let material touch the floor from the beginning to the end. All cranes were installed by the Northern Engineering Works, and are driven by General Electric motors, which are hand controlled from the floor. All machines are electrically driven, either in groups or independently, by Crocker-Wheeler motors.

To meet readily the condition of drilling the necessary holes in the ends of stoker frames, the radial drill used for this work has been laid on its side, making the otherwise awkward operation easy.

The old style method of cutting keyways has been discarded, a new machine being installed on which all sprockets and gear keyways are cut.

The gear is secured to one end of a central spindle, so arranged that one pass of the tapered cutter through the gear completes the keyway.

To provide for the convenience of the men a hot water heater is located over the boilers and piped to about the center of one side of the shop. Each man is provided with a separate locker, and Mr. Harrington has devised a very effective and simple wash bowl, hung and turning on suitable trunions to empty, the

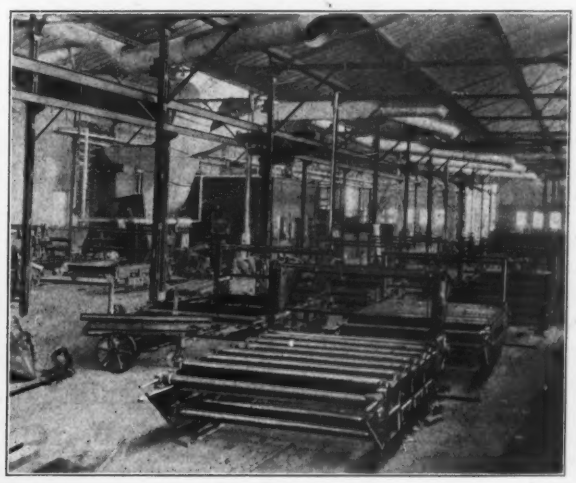


FIG. 4. ERECTING FLOOR WITH HEATING FAN AND WORKS' OFFICES IN THE BACKGROUND, SHOWING A GROUP OF STOKERS BEING ASSEMBLED

waste being cared for by a long central gutter extending under all. This avoids all plumbing with its liability of clogging up small pipes, and the first cost is less.

Power Plant

The boiler room equipment consists of 2 80-h. p.

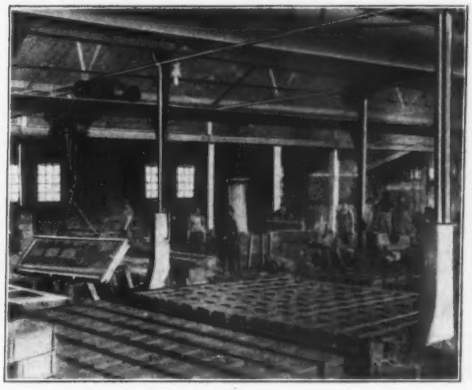


FIG. 5. CUPOLA SIDE OF THE FOUNDRY; AND MOLD FLOOR MOLDING MACHINES

horizontal return tubular boilers, 66-in. diameter by 16 ft. long, carrying steam at 125 lb. They were built by the Bass Foundry and Machine Works of Fort Wayne, Ind., and are suspended from overhead girders and equipped with Green (traveling) chain

stokers. These are driven by a 2-h. p. Wachs vertical engine. Ordinarily only about 0.5 h. p. is required, the remainder being used for experimental work.

Stokers

In the new Green chain grate stoker, for coking

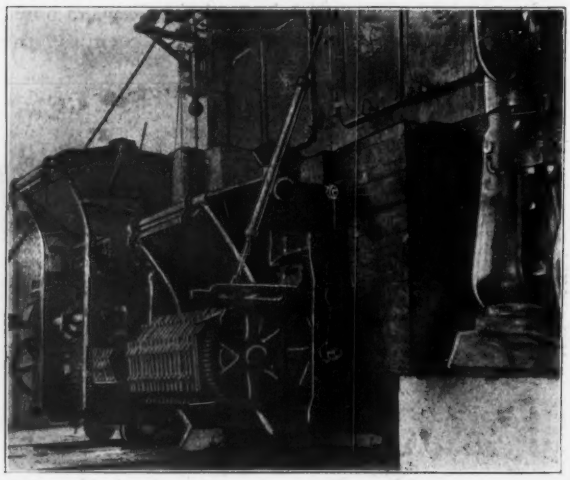


FIG. 6. STOKER EQUIPMENT IN THE BOILER ROOM

coals, a real step in advance has been attained. In the usual stoker, coking fuel coming from the hopper or magazine to the grate cakes and mats together, allowing the ash and clinkering substances to cover the grate and thus retard combustion, making it incomplete, with the attending losses.

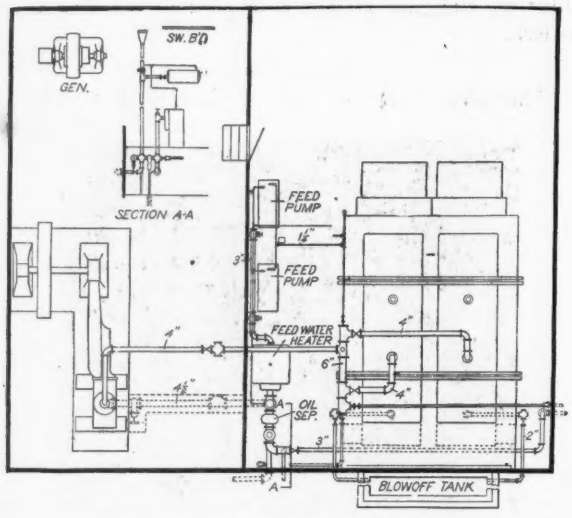


FIG. 7. PLAN OF POWER PLANT PIPING

Again, the temperature in the fire box varies considerably, tending to poor economy, by allowing the products of combustion to strike at once on the cooler metal surfaces of the boiler, thereby chilling them, and reducing the temperature below that required to complete combustion.

The fuel hopper or magazine is secured to the supporting frame, which in turn is bolted at each end to the substantial side frames. The grate surface proper, consists of a large number of small grate links traveling in an endless chain over suitably placed rollers.

Across the boiler front at a convenient height from the floor a line shaft is hung, and on this shaft is an eccentric, imparting a reciprocating motion in a vertical plane to a rocker arm. This arm has secured at one end a pawl, which travels over and engages with the teeth of the main gear on the shaft of the driving sprocket. The motion so imparted to the driving sprocket can be varied, by which means the supply of fuel to the furnace is regulated to meet the conditions.

FIG. 8. STEEL AND PIPE YARD WITH STOKER SECTIONS IN FOREGROUND

Driven by the main chain of gears is another small shaft, directly under the hoppers. Mounted on this shaft an eccentric gives motion to the agitating plates, over which all fuel must pass and become coke before reaching the bed of fuel on the grate.

Suitably placed peep holes and doors allow the conditions of the fire to be seen.

The reverse fire brick arch shown in Fig. 9 causes the intense heat of the incandescent fuel to impinge on the fuel on the agitating plates, coking the fuel as before described and insuring the necessary temperature for complete combustion.

The feed water is heated in a Cochrane open heater by exhaust from the engine. Feeding of boilers is cared for by a 4 by 6 by 4-in. duplex steam pump, built by the Platt Iron Works, of Dayton, O.

Natural draft is furnished by a steel, guyed stack 4-ft. diameter and 120 ft. high.

The engine is a girder frame simple Murray-Corliss 12 by 30-in. running at a speed of 105 r. p. m., and rated at 100 h. p. The engine is belted to a 65-kw. Crocker-Wheeler generator, which supplies all lighting and power circuits. A Cochrane steam separator in the steam pipe directly over the throttle insures dry steam to the engine.

Heating

The shops are heated by the direct-indirect system with steam. The exhaust from the engine and auxiliaries being used in the coils over which fans force the air to the various points in the shop. The system was built and installed by the Andrews and Johnson Co., of Chicago, Ill.

At present the plant is employing about 125 men and turns out a stoker per day. The capacity of the

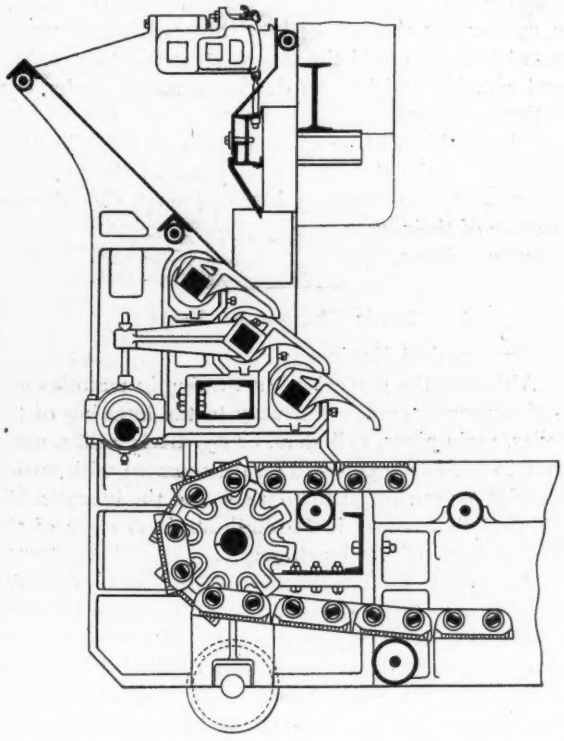


FIG. 9. SECTION OF NEW TYPE GREEN STOKER FOR COKING COALS

plant when fully completed is 250 men and 45 stokers a month.

The officers are: President, P. Albert Poppenhusen; treasurer, Herman A. Poppenhusen, and general superintendent, Joseph Harrington. W. L. Fergus, Fisher Bldg., Chicago, acted as consulting engineer.

RATIO OF EXPANSION

Assume an engine to have a low-pressure cylinder, the area of which is, say, three times the area of the high-pressure cylinder. When the pistons move 1 in., the number of cubic inches of steam behind the low-pressure piston will be three times the number behind the high-pressure piston. When the low-pressure piston moves 1 ft. the volume of steam behind it will be three times the volume of steam behind the high-pressure piston when it moves 1 ft. Therefore, for each volume in the high-pressure cylinder, there will be three volumes in the low-pressure cylinder. The number of volumes or expansions in the high-pressure cylinder is found by adding the clearance to the length of the stroke up to the point of cutoff, then add the clearance to the length of the whole stroke and divide the latter by the former.

If the point of cutoff is given as a fraction of the stroke, then add the percentage of clearance. Suppose the steam in the small cylinder occupies three times the space at the end of the stroke that it did at the point of cutoff. The number of volumes or expansions is three. Now, when the low-pressure piston moves 1/3 of the stroke, the latter cylinder will contain as much steam as the whole of the high-pressure cylinder. When the low-pressure piston moves to two-thirds stroke, the three volumes or expansions in the high pressure will have been expanded again, making six in all, and when the low-pressure piston completes the stroke each of the three volumes in the high-pressure cylinder will have expanded again, or three times, thus making nine volumes or nine expansions.

It will be seen that it makes no difference how far the piston moves in the stroke, when both move the same distance, the volume behind the large piston is always as much greater than that behind the smaller piston as the area of the larger piston is greater than the area of the smaller piston. Therefore, it is not necessary to know how far the large piston moves. All we need to know is the ratio of the area of the

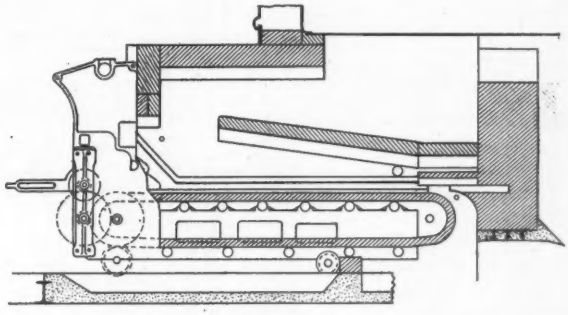


FIG. 10. REVERSE ARCH FURNACE FOR USE WITH COKING COALS

large cylinder divided by the area of the smaller one. The number of expansions is found by multiplying the number obtained in the high-pressure cylinder by the ratio of cylinder areas, that is, by the area of the large cylinder by the area of the smaller one.

ONE POUND OF WATER requires 966 heat units for its evaporation into steam and atmospheric pressure. Assuming that the heating value of a good coal is 14.500 B. t. u. with a perfect boiler and furnace, this coal will evaporate, theoretically, 14.500 divided by 966 or 15 lb. of water. Assuming an efficiency of 70 per cent, the pounds of water which would be actually evaporated would be, therefore, 15 multiplied by 0.70 or 10.5 pounds.

LETTERS FROM ENGINEERS

Send us descriptions of ways of doing new things, and new ways of doing old things. Rough pencil sketches and letters are all right; we will fix them up for the printer. All accepted contributions will be paid for when published.

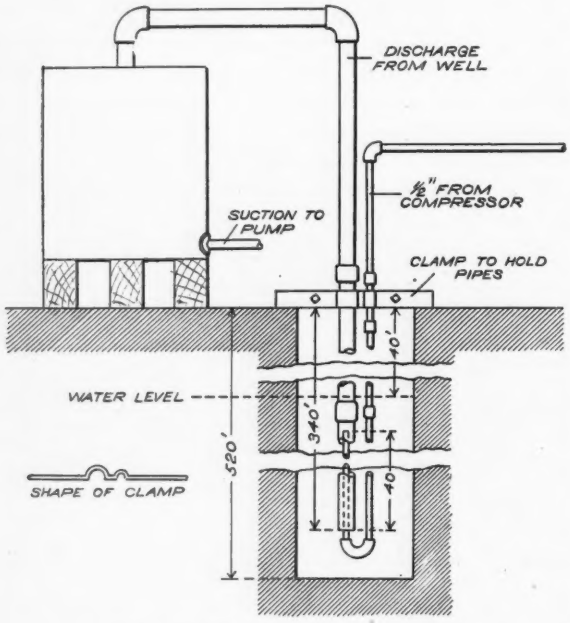
Raising Water by Air Lift

Editor Practical Engineer:

Driven wells are becoming more numerous every day, and there are so many of them in which the water level is below the lift of pumps that it becomes necessary to use some other method if any benefit is to be driven from the wells.

In one place where I was employed it became necessary to use one of these wells with the water level 40 ft. below the surface. The method employed to get the water up is shown in the illustration.

In the plant we had a number of air compressors,



ARRANGEMENT OF PIPING FOR AIR LIFT

so we run a 1½ in. pipe into the well, 340 ft. below the surface, with a ½-in. pipe connected into the bottom as shown, the ½-in. extending up into the 1½-in. pipe 40 ft. The ½-in. pipe was to carry air from one of the air compressor tanks and force the water up the 1½-in. pipe into a tank. From the tank the water was pumped to different sections of the plant for various uses.

With the arrangement as shown, air enters the bottom of the pipe and forces out a quantity of water, then comes the air that was forcing the water up. So the water and the air leave the discharge pipe at equal intervals, first water and then air.

In this way we were able to use a large quantity of water that heretofore had been beyond our reach. In connecting the piping into the well, some means must be used to hold the pipe from getting away. We used a tackle and ball an da clamp placed under one of the couplings.

I hope this will be of some help to some brother engineer. I find lots of useful ideas in the practical letters, and think more o fthe engineers should send in some of their ideas.

Boston, Mass. E. R. S.

Static Charges on Belts

Editor Practical Engineer:

Although the explosions happening in factories and engine rooms are due generally to the bursting of the boiler, main pipes, cylinders, or flywheels, still a great many, which are explained on the moment with wrong theories, or remain in the darkness of the inexplicable, will find their cause in the high static charges of the driving belts of the machinery.

According to Dr. Richter, belts, and especially those treated with resinous matter, in order to attain a greater adherence, are the seats of powerful static charges, due to the dryness, both of the belts and the surrounding atmosphere, and to the velocity at which the belts are driven. In this case the dry atmosphere, charged more or less with metallic dust, acts as a frictional brush on the surface of the belt, which collects in its center the charge, the intensity of which depends upon the dryness of the two frictional elements and the velocity at which they are operating. With a belt 5¼ in. wide, driven at 600 to 2,000 r. p. m., the potential of the charge, measured at the center, was 13,000 volts, and the discharge produced a spark 1 to 1.5 in. long.

In another experiment with a belt 1⅝ in. wide, at the velocity of 18 r. p. m., a charge resulted of 1,800 volts. Naturally, with these high potentials and a surrounding atmosphere dry and loaded with dust and vapors of oils or other gases, a sudden discharge results in a terrific explosion, almost like those generated in the exploding chambers of guns or torpedoes. Various expedients were tried to overcome this danger. The coating of the belt with dust of bronze or aluminum didn't give any satisfactory result, and after a long series of experiments glycerine proved to be an efficient medium in keeping the belt thoroughly moistened and soft. The glycerine for this purpose must be pure and free of acids, and the mixture, which so

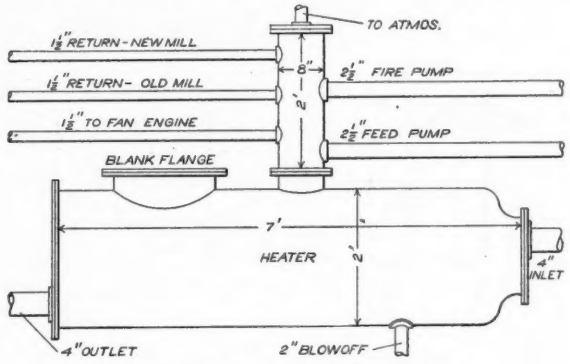
far has given the best results, consists in 1 part of glycerine and 1 of water, thoroughly mixed and applied weekly with a soft sponge on the surface of the belt while in motion. It is also worthy of note that besides softening and protecting, glycerine improves the condition of the belt and adds to its life.

Chas Pagano.

A Novel Heater

Editor Practical Engineer:

I am sending a drawing of a novel heater which



NOVEL HOME-MADE HEATER

we installed a few weeks ago. The old heater was all in and the owners did not want to lay out money for a new heater, so we rigged up an old condenser tank as shown in the drawing, and it is working satisfactorily along with an economizer.

William Stringer.

Boiler Setting Precautions

Editor Practical Engineer:

Talks with a Chief Engineer, by Wm. Kavanagh, are always interesting, but I am sure the examiners in this state would have some criticisms to make of his sketch of a Setting for Tubular Boiler, which was in the May issue.

He says: "When subjected to heat the boiler tends to lengthen and also increase its diameter," but in his sketch, if the boiler should expand, it would move the back arch or the boiler front, as no room has been allowed for expansion. A space representing 0.5 to 1 in. should have been left between the back arch and the boiler.

He says: "The lugs of boilers are placed on rollers," and his sketch shows rollers under both front and rear lugs. Rollers should not be placed under the front lugs, as these rest directly on the iron plates. The reason for this is that we do not wish the boiler to disturb the front and this it would do, if it were allowed to expand that way. Plenty of room should be given for the boiler to expand toward the rear.

The gauge cocks should have been connected to the water column; that being the proper location with this type of boiler.

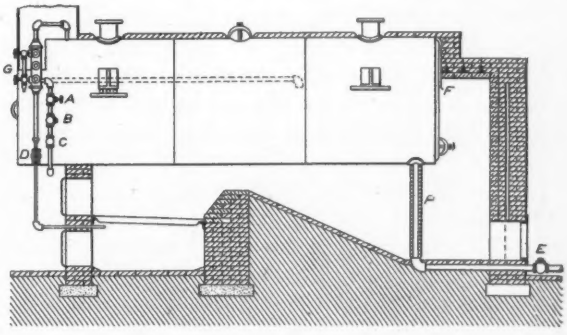
He says: "When a circulating pipe is connected in the blow down a circulation is set up which prevents the pipe from becoming filled with scale." With a circulating pipe, connected as his sketch shows it, there may be a very little circulation in the blow off pipe, due principally to the condensation of steam in the circulating pipe, but this circulation is certainly not enough to disturb the scale and sediment in the blowoff pipe, and when he says: "When no means for circulation is attached to the blow down pipe it fills with mud and scale." I certainly shall have to disagree with him. Rank negligence is the only thing, with ordinary water, that will allow a blowoff pipe to fill with mud and scale. A boiler should be blown down often enough to keep the blowoff pipe clear and, in this state, boilers with circulating pipes are few and far apart.

His sketch shows a globe valve in the blowoff pipe. This is something that the Massachusetts State Board of Boiler Rules prohibit. A straightway valve or cock should have been used.

The opening in the back wall where the blowoff pipe passes through, should have been of such a size that a cast-iron sleeve could be put on the blow-off pipe, thus providing for free expansion and contraction.

The feed pipe in his sketch is not in accordance with modern practise. It should enter the front tube sheet, on the side, just above the upper row of tubes and run back 3/5 the length of the boiler, then cross over the tubes and discharge at or about the center row of tubes above the upper row.

As he has them arranged, the gage glass and water



TUBULAR BOILER IN CORRECTED SETTING

column cannot be blown out. They should be blown down several times a day.

The slope he has given the rear of the bridge wall does not end until it reaches the back wall. This certainly is not proper. The slope should come to an end when it reaches the back end of the boiler so that whenever it becomes necessary to work in the back connection it may be done by a man who is not a contortionist.

The grates are set level, while they should pitch to the rear about 0.5 in. to the foot.

The overhanging front style of boiler should be given the preference over the flush front style, as there is no liability of burning the dry sheet on the overhanging front.

When the heated gases are carried over the shell, as his sketch shows, it is more liable to be a detriment than an advantage: for, if it should be necessary to force the fire when starting up, there is a chance that the shell might be injured or, if we carry a very high steam pressure, the temperature of the gases that pass over the top of the boiler may get low enough to take away some of the heat from the boiler instead of giving up heat.

A boiler should always be made so that it may be thoroughly inspected inside. His sketch shows neither manhole nor handhole plate.

The sketch herewith of a setting for a tubular boiler will, I believe, come nearer to the requirements of an examiner. T. G. R.

Safety Valve Area

Editor Practical Engineer:

A question which has often occurred to me is, why are there so many different rules for finding the area of a safety valve?

I have selected a few which I have seen in various books written by men with a reputation for engineering knowledge, and I give them here as representative casts.

Taking for an example one of the boilers in my charge which is rated at 125 h. p. It has a 6 by 6 ft. grate, 2 3-in. spring loaded safety valves, and the pressure is 80 lb.

The Philadelphia Department rule, also called the French rule, states: Multiply the grate area in square feet by 22.5; divide this by the sum of 8.62, added to the gage pressure in pounds per square inch. The quotient will be the area of the safety valve in square inches.

$$36\times22.5\div(80+8.62)=9.14 \text{ sq. in.}$$

By Rankine's rule the area is 0.006 times the pounds of steam used an hour. As we are considering a 125 h. p. boiler, $125\times34.5=4{,}312.5$ lb. of steam an hour, and $4{,}312.5\times0.006=25.875$ sq. in., area of the valve. Considerable difference, don't you think? Between these 2 extremes are several other rules.

The U. S. Navy Department rule is: Area in square inches equals 0.005 times the steam per hour in pounds. $4{,}312.5\times0.005=20.5625$ sq. in. area.

In the International Correspondence School's textbook, is a rule: Area in square inches equals 0.5 times the pounds steam an hour divided by the sum of 10 and the boiler pressure gage:

$$0.5\times4{,}312.5\div(10+80)=22.84 \text{ sq. in.}$$

For spring loaded valves the U. S. Steamboat Inspection law allows 1/3 sq. in. area for each square foot of grate, and as the grate contains 36 sq. ft., 12 sq. in. area of valve would be sufficient.

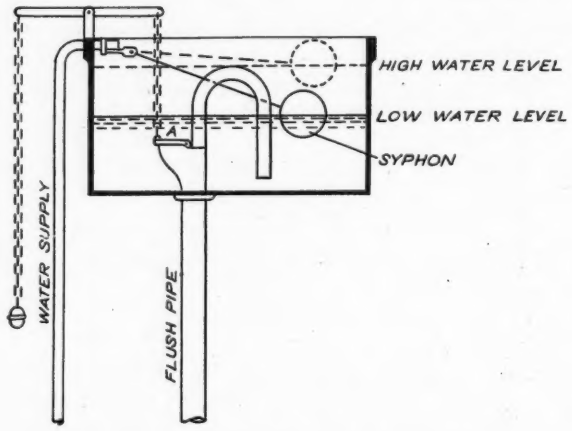
As equipped, the boiler has 2 3-in. valves, giving a combined area of 14.1372 sq. in. Why should there be this great difference in these formulas? Surely it must be possible to have a standard proportion, all boilers are not equipped alike, and while some are supposedly safe, some are surely deficient in valve area.

I would like to hear from other engineers on this subject. Harry H. Yates.

Saving Water

Editor Practical Engineer:

On taking charge of a large office building, the



ALTERATION OF FLUSH TANK SIPHON

superintendent said that there was one thing he wanted very much, and that was to cut down the water bill, which he said was altogether too large for such a building.

I went over all pumps, elevators, valves in sinks, washbowls, ball cocks in toilets, and had everything made tight.

The pressure tanks were blown down only once a week and only enough then to carry off the sediment. Still the superintendent said that the water bill was too large. He showed me a number of water bills some months back and said that the water now ought not to be any more.

I asked him how many tenants he had in the building at that time, and he said that a few over half of the rooms were occupied then.

I told him the difference was due to the extra number of tenants in the building now, but he could see it only one way; the water bill was too large.

The building had about 160 toilets in all, and working on the idea that the extra water was used mostly in these, I tried to think of some way of making a saving in the water without incurring a large expense.

After some thinking I had a man take a small hand drill, and after shutting the water off and emptying the flush tank, drill a 1/16-in. hole in the siphon pipe

a little over half way from the top. As this bend is made of tubing it was very easily done.

I then had the water turned on to try the results. The hole did the work. As soon as the water level reached the hole, the siphon broke, and thus saved about ½ the water in the tank.

Doing so well with the first, I had all the siphons fixed the same way, and the superintendent was more than pleased when he got his next water bill. He said, "I knew it could be done," but he was from Missouri and had to be shown.

In the sketch, when the chain is pulled, it lifts valve A and starts the siphon so that the water runs out until it reaches the hole. The weight of the valve

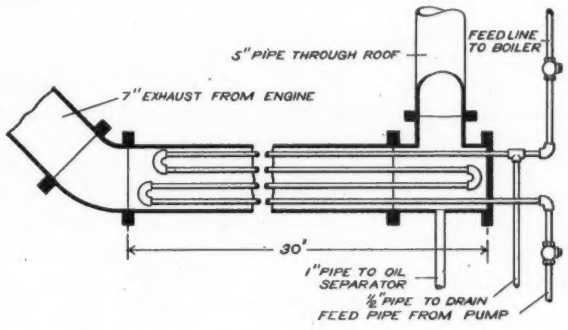


FIG. I. HOME-MADE FEED-WATER HEATER

and the water on it closes it as soon as the chain is released. E. R. S.

Feed Water Heater and Oil Separator

Editor Practical Engineer:

Enclosed are sketches of a homemade feed water heater and oil separator.

The end view of the heater shows the pipes as they come through a 2-in. board bolted to a flange on the end of the heater. The exhaust is a 7-in. pipe 30 ft. long from a 45 deg. coupling to the extreme end. That gives about 120 ft. of heating pipe. The feed pipe is 1.25-in. to feed a 200 hp. boiler, which is close to the end of the heater.

As the engine is a Westinghouse Automatic Compound, quite a lot of oil works out of the crank case up through the low-pressure cylinder and into the exhaust pipe or heater. I, therefore, made an oil separator and placed it at the end of the heater nearest the boiler, and it catches from 1 to 1.5 qts. of oil a day. The separator is made of 1-in. lumber, 4.5 ft. long, 1.5 ft. wide, 1 ft. deep, with 3 compartments for oil. As the oil and water coming through the heater are hot, the separator doesn't get all the oil from the water in 1 compartment, hence, I made 3, and get practically all the oil.

The first partition runs from the top to within 1 in. of the bottom and the second is about 1.5 in. from the first and runs from the bottom to within 2 in. of the top. As the oil works to the top of the water, always, the water passes through under the first partition up between and over the top of the second into the second compartment. The partitions in the second compartment are practically the same as in the first, only where the water passes over the partition must be 3 in. from the top of the separator, and the outlet from separator is a hole 4 in. from the top. The separator should be made of galvanized iron. S. L. S.

Examination Questions for Hoisting Engineers

Editor Practical Engineer:

Herewith is a list of 15 questions of the written examination for certificate of a hoisting engineer, held at Springfield, Ill. I would like to see answers from your readers.

1. What do you consider should be the general character and habits of a person coming before the mining board asking for a certificate as hoisting engineer?

2. What are the duties of a hoisting engineer at coal mines in our state as defined by the state law?

3. What is the first duty of a hoisting engineer, when he takes charge at the beginning of a shift?

4. How much water should the boiler contain when in use, and how much water when the mine is not working?

5. In case the water should become dangerously low, in any of the boilers, what would be the duty of the engineer?

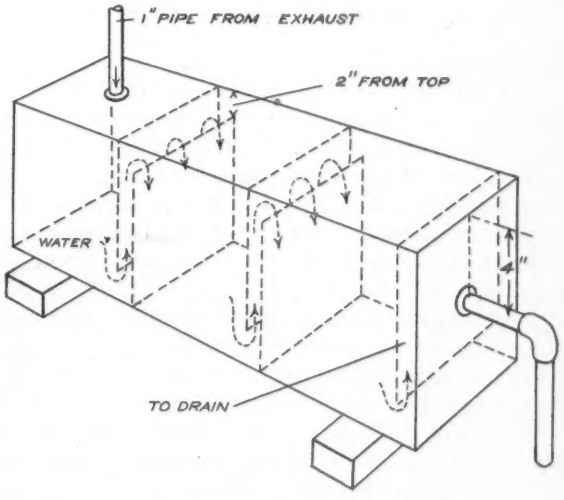


FIG. 2. HOME-MADE OIL SEPARATOR

6. In case the water supply should be cut off from any of the boilers, for a short time, what would be the duty of engineer?

7. What is the proper and most economical way to fire a boiler, and how can the engineer avoid excessive firing?

8. How should an engineer keep his safety valve,

and how often should he move it to see if it is in order?

9. In case an engineer has a glass water-gage, why should he not neglect his gage cocks?

10. What is the cause of foaming in steam boilers, and what is the best preventive against foaming?

11. An engine having a cylinder 24 by 36 in., using 60 lb. of effective steam pressure per square in., is connected direct to a drum 8 ft. in diameter; neglecting friction of the engine, how much will the engine lift in pounds?

12. The water end of a pump has a diameter of 6 in., the pump is running at a speed of 100 ft. a minute; neglecting leaks in the pump, how many gallons of water is it delivering a minute?

13. In electricity what is an ohm, a volt and an ampere?

14. The current supplied to an electric motor is 100 amperes and the pressure between the mains is 250 volts, what is the horse power of the motor?

15. A horizontal return-tubular boiler has the following dimensions: diameter, 72 in.; length of tubes, 18 ft.; external diameter of the tubes, 4 in.; number of tubes 70, what is the heating surface of the boiler in square feet? James C. Stewart.

Here is a chance for readers to sharpen their wits and their pencils. The two best sets of answers will be published and paid for.—Editors.

Careless Plant Owners

Editor Practical Engineer:

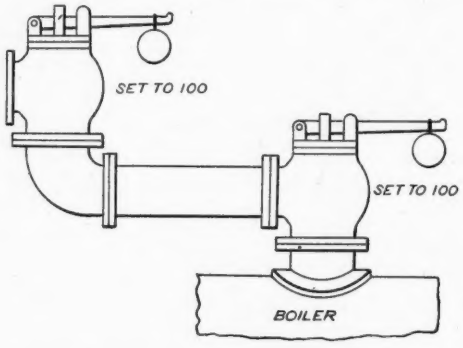
A habit once formed, whether good or bad, is very difficult to overcome. There isn't a person but that has a habit, good or evil. Where is there a fireman, an engineer, or any employe around the steam plant who is going to keep things in a more than "just so it goes" condition, when the owner or manager is careless and never comes into the boiler room or engine room, to see if things are in good condition and everything in good running order? More than that, not even take enough interest in the boiler or engine room attendants' condition or welfare, to ask them how things are, and whether there are any repairs needed; and if there are any needed they seem to think that it is not absolutely necessary today, but that tomorrow or day after will do.

"Never put off until tomorrow what you can do today," would be a good motto for a great many employers and managers to heed. I know of an instance where a fireman in a certain steam plant became careless from the fact the manager was very careless. He would not do any more than was aboslutely necessary. He swept the floor where he walked, the ashpit was cleaned when it would not hold any more, the pumps were not accessible without an abundant application of waste to eliminate the grease, and everything in general was in a condition not pleasing to the eye.

I know of another instance where, just recently, an engineer left an electric railway power station for the simple reason that there were no tools or anything for making repairs of any kind.

If managers and owners of steam plants would stop to think of what kind of an example they are making for their employes by being careless and saying, that will do for a while yet, I haven't time to tend to that just at present, etc., then act according to the promptings of their conscience, there would be less careless firemen, engineers, and there would be a vast difference in the appearance of boilers, boiler rooms, engines, etc.

An instance where the above conditions exist was observed by the writer just the other day, when the manager came into the boiler room with a smile on his face, and greeting the fireman, asked how things were, and how the pumps were working. Everything there seemed to be in harmony. E. A. L.



SAFETY VALVES ARRANGED IN TANDEM

Safety Valves in Tandem

Editor Practical Engineer:

At what pressure will the second safety valve blow in the accompanying illustration? The second valve is piped to the exhaust of the first, and both valves set at 100 lbs.

It is evident that with 100 lb. in the boiler the first valve will open, and as soon as a pressure of 1 lb. accumulates above the seat of the first valve it will close it, the same as a reducing valve on a steam main. It will remain closed until the pressure in the boiler rises to a little over this pressure, because the valve is 45 deg. bevel, making more area on the top of the valve than the bottom, consequently a pressure of 1 lb. above the disk of the first valve will mean 4 or 5 lb. more required in the boiler to lift it again, and so this will continue. Every pound accumulated above the first valve acts to hold down the valve and when the pressure rises to 100 lb. on top of the first valve, the second valve will commence to blow.

The solution to this is that the spring tension in the first valve is 100 lb. and then the pressure of accumulated steam due to the first valve blowing is 100 lb. more, plus the extra area of the top of the valve, amounting to less than 4 sq. in., consequently the

pressure in the boiler will have to be approximately 205 lb. before the second valve will blow at 100 lb., for which it is set. A. C. Waldron.

STEAM AS A FIRE EXTINGUISHER

Editor Practical Engineer:

In regard to the article by A. G. Williams on the above subject, I can say from my own experience that it can be so used.

Some years ago I was employed as engineer in a large paper mill in Wisconsin, and as may be known by those who are familiar with such plants, the rag sorting rooms contain the greatest source of danger from fire, there being many small pieces of iron and steel mixed in with the rags, which in passing through the rag cutters frequently cause fire to start in the rag dust with which these rooms are generally thickly filled.

The superintendent of this particular mill, which by the way was a new one when I took charge of the steam end, requested me to run steam pipes 3 in. diameter, to each of the rag rooms. These pipes were controlled by a valve in the engine room.

This, of course, was a somewhat crude method, but in 1 case it served the purpose well. During the night, the watchman, in making his rounds, discovered a fire of quite good proportions, and immediately ran down stairs and told the engineer, who opened the valve on the steam main leading to this room. The result was that the room was filled with steam and the fire extinguished before any damage to amount to anything had been done.

This man who had charge of the mill told me of a similar experience in a large mill in Holyoke in which he had installed such a device and with the same result. Of course, it might be unpleasant if the steam in large volume was turned on when people were in the room, although I have found that by keeping down close to the floor, one can manage to get out of a room flooded with steam.

Another instance in which steam played an important part in extinguishing a fire. This was also in the rag room of a paper mill, in this case one of the employes, who had been previously instructed how to act in case of an emergency of the kind happening during the night, on the alarm being given, stopped the rotary rag boiler, with the blowoff valve discharging into the rag room and opened the valve which he could reach from the washer room. The fire was put out with only small loss. H. I. M.

Editor Practical Engineer:

I have read with interest the article "Can Steam Be Used as a Fire Extinguisher?" and I agree with what the writer of that article says about the matter. Steam is used for extinguishing fires aboard ship, both in the naval and merchant service. In the board of supervising inspectors' book of rules and regulations will be found a clause relative to steam pipes for supplying steam to the holds of vessels, lamp lockers, oil rooms and like compartments, where fire is a possibility.

These pipes must be not less than ¾ in. diameter, and are to be equipped with valves that are to be accessible from the main deck of the vessel. Each valve must be marked as to where the steam is delivered through it. Of course vessels are also equipped with fire pumps and other extinguishers as well as with steam pipes, so as to have abundance of protection for all possibilities that may arise.

In specifications for the machinery of war vessels, such a clause as this may be found: "Steam Fire-Extinguishing Pipes to Bunkers."

"There will be a 1.5-in. steam pipe leading from the auxiliary steam pipe to each bunker for extinguishing fire. This pipe will have a valve in it next the auxiliary steam pipe, and another at each coal bunker bulk head. The pipes inside of the bunkers will lead to special nozzles of approved design, fitted near the bunker floors for distributing steam throughout the coal."

It does not remain to be proved that steam will effectually put out a fire on board ship, or at least so hold it under control that port can be made where the fire can be fully handled with the minimum of danger to life and property. Steam will penetrate where water may not, and where the fire is extinguished, much less damage will be done the contents of the compartment in which the fire existed than if water had been used. Steam could be used for the same purpose in buildings on land by employing some such scheme as briefly outlined by Mr. Williams in the article referred to.

Concerning early cutoff by the D valve by adding more steam or outside lap to a given slide valve, and allowing the other existing conditions to remain as they are, an earlier cutoff can be obtained without materially interfering with the release and compression events of the stroke, for the travel of the valve will be the same as before the lap was added, the eccentric position with reference to angular advance is the same, and the exhaust events have not been changed. But, by adding the outside lap, and getting an earlier cutoff, lead and port opening must be sacrificed, to a certain extent at least in the case of the latter, and wholly in the case of the former.

While I fully believe that lead can be advantageously done away with in most engines, if not in all, lessening the port opening of an existing engine is not a good thing to do. By designing an engine with extra large ports, so that the port opening given by the valve with the added lap will be sufficient for the needs of the engine, then early cutoff may be obtained. But, if lead is insisted upon, then it cannot be done successfully, and it will be difficult to convince most engineers that steam lead is not an absolute necessity for all engines and all kinds of valves.

Charles J. Mason.

HINTS FROM THE TROUBLE MAN

Soldering Fluid

For soldering, when it is desired to avoid rust or discoloration, the following fluid will be found handy:

2 oz. alcohol, 3 oz. glycerine and 1 oz. chloride of zinc crystal.

Fire Stop

To prevent fire caused by a defective lamp socket,

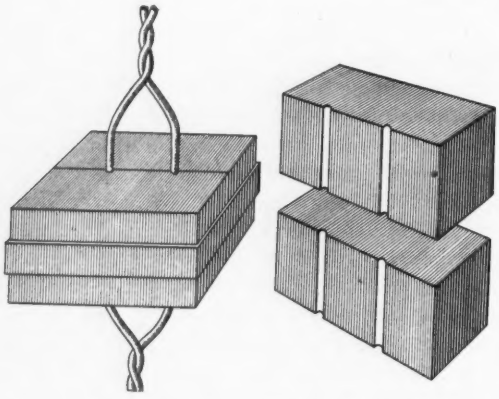


FIG. 1. ASBESTOS FIRE STOP FOR LAMP CORDS

or by a paper or celluloid shade on an incandescent lamp bulb from creeping up the supporting cord and starting a serious blaze, two blocks of asbestos may be fitted over the wires near the lamp and held by wires. These blocks are each about 2 in. long by 1 in. wide and 0.5 in. thick.

Heat Proof Putty

Mixing a handful of burnt lime with 4.25 oz. of linseed oil, boiling down to the usual consistency of putty, and allowing the plastic mass to spread out in a thin layer to dry in a place where it is not reached by the sun's rays, yields eventually a very hard putty. When required for use it is made plastic by holding over the funnel of a lamp; on cooling it regains its previous hardness.

Boiler Leak by Compressed Air

Enclosed is a small kink that may come handy to some of your readers. I am employed in a plant where the water supply comes from a tank on the roof, the tank being supplied from a deep well pump. We have only one boiler and in washing the same it is absolutely necessary that the manhole gaskets be tight before filling the boiler, for, if the top gasket leaked and it was necessary to kill the boiler we had not water enough left to fill the boiler a second time and, of course, could not pump any without said boiler being under steam.

Now when filling the boiler the bottom manhole would show any leak but with the top one it was different; but by closing all outlets the incoming water immediately compresed the air in the boiler and by holding a match to the seam of the top gasket any leak could be discovered by the escaping air.

I have followed this method for the past 3 years and during that time have found 3 different cases

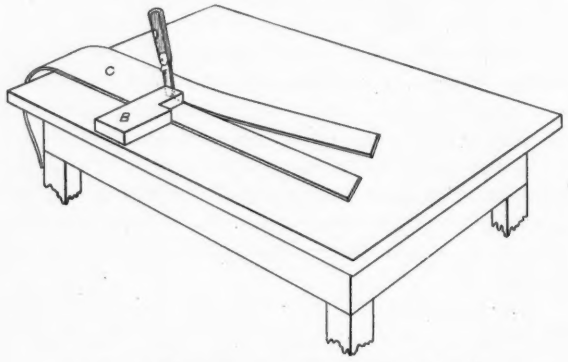


FIG. 2. METHOD OF CUTTING BELT LACING

where the boiler would have had to be killed had it not been discovered by the large leakage of air.

James Browning.

Cutting Belt Lacing

Using a sharp pocket knife, A, a block, B, with notch the width of lacing required and leather, C, with the knife driven into a bench, lacings may be rapidly cut to uniform width.

Plaster Patch

For filling holes where plastering has been broken, a mortar made of 2 parts sifted coal ash, 2 parts sand and 1 part wheat flour is excellent. It is cheap, easily handled and becomes hard as stone.

Oilways

Sometimes a bearing which bothers by heating up

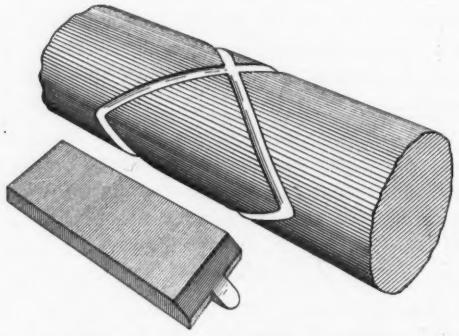


FIG. 3. TOOL FOR CUTTING AND FORM OF OILWAY

may be fixed by cutting oilways in the shaft or crank-pin with a chisel having a teat on the end as in Fig. 3. These oilways should be in the form of an X with the cross opposite the oil hole, or of a double X with the ends joined as in Fig. 3.

SETTING D SLIDE VALVES

IN SOME engines of this type a rocker arm is used to modify the motion imparted by eccentric to valve.

Equalizing Rocker Travel

When the rocker arm is hung at one end and the eccentric rod and valve stem move in the same direction, as in Fig. 1, the motion is said to be direct connected. When the rocker is hung in the center and the eccentric rod and rake stem move in opposite directions, as in Fig. 2, the motion is indirect connected.

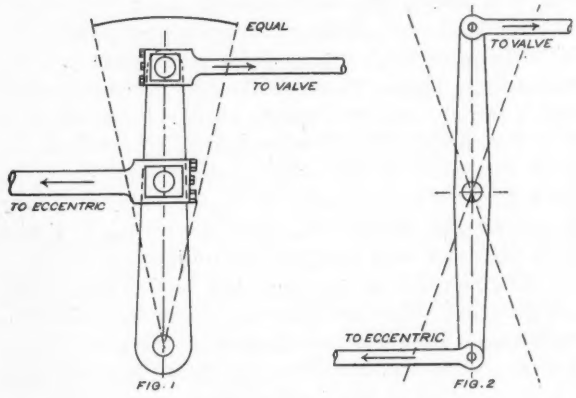


FIG. 1. DIRECT ROCKER ARM

FIG. 2. INDIRECT OR REVERSING ROCKER ARM

First cause the rocker arm to travel equally on each side of its center line, as shown in Figs. 1 and 2. To do this adjust the length of the eccentric rod.

Placing on Center

Then place the crank on the dead center. One way to do this is to place a level along the planed edges of the crank pin boxes, barring engine till dead level.

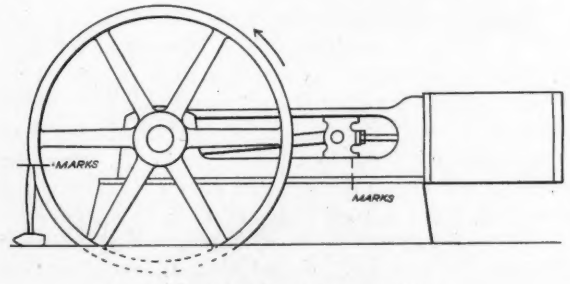


FIG. 3. FINDING DEAD CENTER

Another and perhaps more accurate method is to tram the flywheel as shown in Fig. 3.

To do this place the cross head near the end of the stroke and make a mark on crosshead and guide in line with each other. Now stand a hammer or wrench on end on the floor at rim of flywheel and make a mark opposite the end of the hammer or wrench handle. Turn engine over center and continue till the mark on cross head is again in line with that on guides. Then again mark the wheel at end of hammer. Now divide the distance between the two marks in the center and again mark the wheel. Turn the wheel again till the last mark is opposite the end of hammer, when the engine will be on exact dead center.

Equalizing Valve Travel

Next square the travel of the valve over its ports. To do so turn the eccentric around on the shaft (it not having been secured) from one dead center to the other, and see that it opens each port the same amount; if not, adjust the position of valve on stem until it does. Then turn the eccentric, if direct connected, ahead on the shaft till the port is opened the desired lead, ranging from 1/32 to ⅛ in., depending on the size and speed of engine. Secure the eccentric.

If the rake is indirect connected, turn the eccentric on the shaft in the opposite direction to that of rotation till the desired lead is obtained.

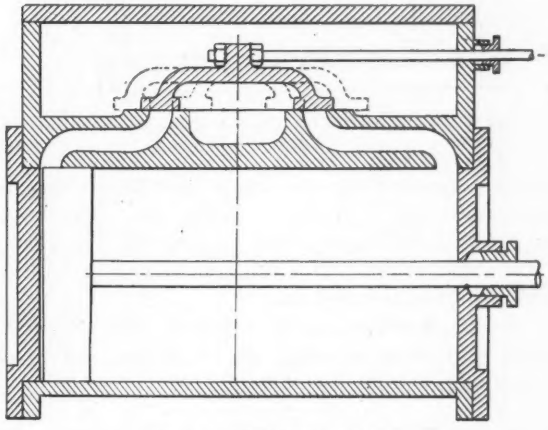


FIG. 4. SQUARING VALVE

Turn the engine over to the other dead center, and if there is any great difference in the leads it can be corrected by changing one half the difference by moving the valve on the stem and the other half by changing the position of eccentric on shaft.

SETTING THE MEYER VALVE

THE main valve in this gear controls the admission, exhaust and compression, same as the simple D slide valve. The travel of the main valve is squared the same as the D valve.

The lead in the main valve of the Meyer gear is visible through the ports A in the main valve as per sketch.

Having the main valve travel squared and given the required lead, place the valve in the center of its travel, or square.

This can easily be done by turning the main valve eccentric to each of the extreme positions and marking the valve rod in line with the stuffiing box. Then

divide the distance in the center and with eccentric secured to the shaft, turn the engine until the center line on the valve rod comes opposite the stuffiing box. The main valve is then squared.

Now proceed to square the travel of the riding plates over the ports of the main valve. Turn the engine to that part of the stroke where it is desirable for the cutoff to take place. Turn the riding eccentric on the shaft in the direction of rotation until the cut-

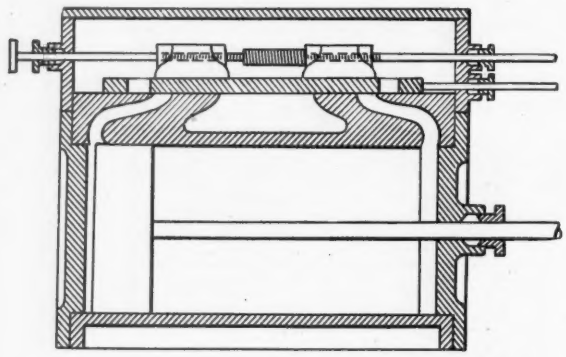


FIG. 1. RIDING VALVE SQUARED OVER MAIN VALVE

off plate approaching the steam port just closes it; then secure the eccentric. Turn the engine over and see that the cutoff takes place at the same point in the other stroke. If not, move the plate for that end till such is accomplished.

The hand wheel, when required, will move the plates into such positions as to change the cutoff as desired.

HOW TO DRAW MANHOLES, HANDHOLES AND ELLIPSES

By William Kavanagh

Kingsley and I arrived at the chief's engine room and found him busy with his accounts and expenses. He told us to be seated and when he was at liberty asked how Kingsley was progressing with his studies. Kingsley said that he was studying hard and thought his next study would be mechanical drawing. "My reason is that I am puzzled about the drawing of a manhole to a given size. I and several other engineers spent considerable time trying to draw a manhole 11 by 15 in., and a handhole 5 by 6 in., but we failed." In fact, Kingsley did not understand much about mechanical drawing, and for this reason he wanted the chief to give him some practical information on this important subject, and especially on the drawing of ellipses.

The chief said that he would, and, after tacking some paper on the drawing board, began as follows: "There are various methods adopted to construct the figure having the elliptic form, and since manholes and handholes are elliptic or partially so, we have to consider these methods. It is not difficult to draw this figure, so I will explain a reasonably accurate method which is in general use.

Method for Drawing 4 by 6 in. Handhole

"I want you to practise this when you go over to your engineroom." Here the chief drew Fig. 1 and continued. "This represents an ellipse 4 by 6 in., and the line A B is called the major axis and the line C D the minor axis. Now, to construct a figure like this, and having these dimensions, draw A B equal to 6 in. and at its middle point erect the perpendicular C D; making C O and D O each equal to 2 in. Bisect O B, that is, divide O B and O A into 2 equal parts, and through the points so found, as K, draw C K F and C K E. Now draw D K P and D K L; from the points K K, with a radius equal to K A, draw the arcs L A F and P B E, and from the points C and D with radius D C, draw the arcs L C P and F D E, which will complete the ellipse.

"The points K K are called the 'foci' of the ellipse, and as these points approach or recede from the center of any ellipse it determines its eccentricity. Thus, you see, Kingsley, the closer the point K approaches

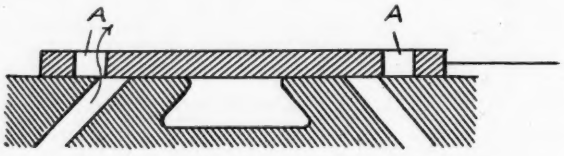


FIG. 2. SHOWING LEAD GIVEN MAIN VALVE

the center O, the nearer the shape of the ellipse is approach to a circle, and this kind of an ellipse is said to be concentric. When the foci points approach B and A the ellipse will become long and narrow and then it is said to be eccentric.

5 by 6-in. Handhole

"To draw an ellipse or handhole 5 by 6 in., we proceed as in Fig. 2, to draw A B 6 in. long and C D 5 in. long, of course, at right angles to A B, and at its middle, with O C and O D each equal to 2.5 in. Now, divide O A or O B into 5 equal parts and take 4 of these parts for your foci points, as K K, from the points C and D and through the points K K draw the lines D K P, D K L, C K F and C K E.

"From the points K K, with radius K A or K B, describe the arcs L A F and P B E, and from the points C and D with radius C D draw the arcs L C P and F D E. This will complete your ellipse, or handhole.

5 by 7 in. Handhole

"To draw an ellipse 5 by 7 in., take 3/5 of O A or O B for your foci points and follow the instructions given about the other ellipses and you will find that to draw an ellipse to a given size is not so very difficult."

Here Kingsley wanted to know why the lines D K, I, D K P, etc., were drawn, and the chief said that

these were drawn to determine the points where the arcs of different radius terminated or met without showing any tendency to diverge; in other words, the arcs met naturally at these points or lines.

Drawing Manhole Shapes

The chief further said, "The drawing of a manhole is just as simple as the drawing of the handhole; to illustrate this I will draw Fig. 4, which is a manhole 11 by 15 in. The line A B is divided into 3 equal parts and the distance K A, or 1/3 of A B, is taken as a radius to draw the arcs L A F and P B F. Then the radius D C is taken to draw the arcs L C P, F D E.

"In drawing an ellipse 10 by 14 in. you take 3/5 of O A or O B to find the foci points and construct the ellipse as described above." The chief said that these measurements were approximately correct, and for all practical purposes were sufficiently close.

Kingsley said that he had no idea that the drawing of the ellipse or manhole was so simple and, if the chief had no objection, he would take a copy of these figures to his engineroom and place them in his reference book, as the sizes given were in every day use. Of course, there are some handholes and manholes that differ somewhat from those sizes, but any engineer with the amount of information that the chief had given, could easily construct a handhole or manhole for any given size. The only thing that puzzled Kingsley about the drawing of the ellipse, was how the chief found the fractional part of the line O A or O B. If O A was of such a length as to admit of an equal number of divisions, Kingsley would encounter no difficulty in finding the required point; but, since O B or O A might be 7 in., and 4/5 of this was required, he thought there would be too much figuring and involving consideration of awkward fractions. Here the chief showed Kingsley that any fractional part of a line could be found without referring to figures and, in order to make this clear, the chief drew Fig. 6 and explained it as follows:

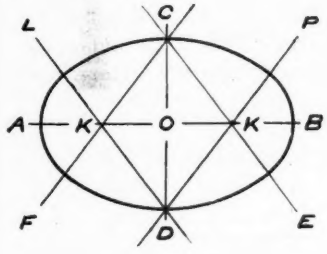


FIG. 1

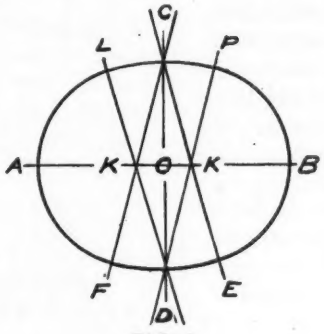


FIG. 2

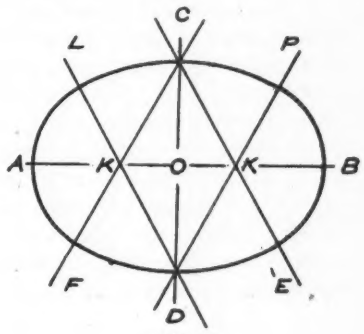


FIG. 3

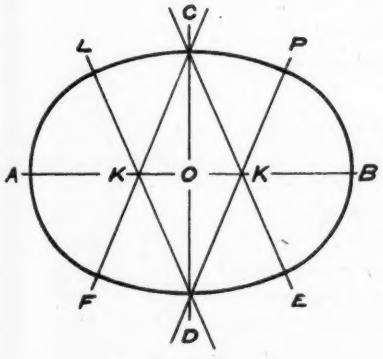


FIG. 4

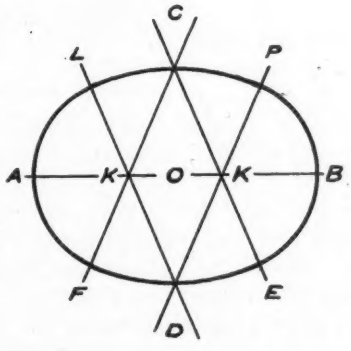


FIG. 5

FIG. 6

FIG. 1. CONSTRUCTION OF ELLIPSE FOR HANDHOLE 4 BY 5 IN. FIG. 2. CONSTRUCTION OF ELLIPSE 5 BY 6 IN. FIG. 3. ELLIPSE WITH AXES 5 AND 7 IN. FIG. 4. MANHOLE ELLIPSE 11 BY 15 IN. FIG. 5. MANHOLE ELLIPSE 10 BY 14 IN. FIG. 6. DIVIDING UP A LINE INTO AN ODD NUMBER OF PARTS

Dividing a Line Into Equal Parts

"Suppose that the line O B was 7 in. long and you were required to find 3/5 of it, then all you need do is to draw any other line at an acute angle, as shown by the line O C, and step off on O C 5 equal divisions. Then join B and C and, parallel to B C, draw the lines as shown. O B will then be divided into 5 equal parts, and 3/5 of O B will be equal to 3 of the parts, and so on. At this point Kingsley had to leave and, thanking the chief for his trouble, we left for our engineerooms.

QUESTIONS AND ANSWERS

Our readers are invited to send in their troubles and problems; also to answer questions which are asked. All letters must have name and address of writer, which will not, however, be published. If answers are wanted by mail, send stamp for reply.

QUESTIONS FOR READERS

S. W.—I would like to hear from some readers how to build a small pipe and fittings boiler to be used for laundry work, also from those who are operating vacuum heating systems, about their troubles and savings.

S. W. T.—What do readers of Practical Engineer consider good economy for a 900-hp. twin engine taking steam at 95 lb. pressure, with 25 in. vacuum, Pocahontas coal well mixed and all fuel charged to the engine for getting up steam, banking fires, etc.? The cylinders are 26 by 60 in., running at 57 r. p. m. The engine is a modern 4-valve Corliss.

A. C.—I should like some of your readers to tell me how to keep the valve bonnets and cylinder head covers of an engine bright. Also what will remove the carbonized oil from them after they have turned black.

QUESTIONS ANSWERED

Thickness of Boiler Plate

J. R. A.—1. If a boiler shell 63 in. in diameter is required to carry a pressure of 135 lb. per sq. in., what thickness should the plate be? Assume the efficiency of joint to be 76 per cent. 2. What is the total horsepower expended in lifting 1,040 lb. 14 ft. per minute? 3. An air compressor cylinder contains 8.6 cu. ft. of air at atmospheric pressure when the piston is at the end of the stroke. When the air is compressed to a pressure of 62.3 lb. per sq. in., absolute, (a) what is the volume of air, assuming that the temperature has remained constant? (b) What percentage of its stroke has the piston completed?

A.—1. The thickness of plate for a boiler 63 in. in diameter and carrying a pressure of 133 lb., with a joint efficiency of 76 per cent, is figured as follows, assuming 60,000 lb. as the tensile strength of the plate, and a factor of safety of 5:

$$\frac{60{,}000 \times 0.76 \times t}{31.5 \times 5} = 135.$$

Solving the above equation, $289.5\ t = 135$. $t = 0.466$ in., which would be the thickness of the plate. Of course, you would have to use the nearest commercial size, which would be 7/16 in.

2. A horsepower is equivalent to 33.000 ft.-lb. per min. Consequently, to lift 1,040 lb. 15 ft. per min., would require

$$\frac{1040 \times 15}{33000} = 0.472 \text{ h. p.}$$

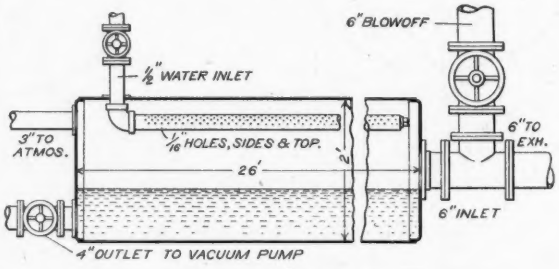
3. The answer to (a) would be,

$$V = \frac{14.7}{62.3} \times 8.6 = 2.029 \text{ cu. ft.}$$

(b) The piston has made 16.4 per cent of its stroke.

Condenser for Blow Off

F. G. McM.—Can you give me an idea for a condenser to take the steam from 1 6-in. and 1 3-5-in. blow off and a 6-in. exhaust. I have an old mud drum 24 in. by 26 ft. and I am getting my water from a well 16 ft. square.



BLOW-OFF CONDENSER

A.—In reply to your question, if you wish simply to condense the steam, you can do it with an arrangement of your tank, as shown in the sketch herewith. This would, of course, mix the cooling water with the condensed steam, so that unless your cooling water is pure the steam would no longer be of any use for boiler feed. If you have a reasonable amount of cooling water you could, however, reduce the back pressure on your engine, but you would need the addition of a vacuum pump to pump the condensed steam and cooling water away from the condenser tank.

Sulphur for Bedplates; Horsepower of Flywheel

C. V. W.—1. How is the sulphur preparation used for engine bedplates best prepared? 2. How is the horsepower of a flywheel on a line-shaft pulley determined?

A.—1. Sulphur is used in the ordinary stick form or lumps, is melted and then poured around the bedplate of a machine for making a setting. There is no special preparation needed, and the only precaution is to putty up around the sides to prevent the sulphur from coming out. There must be, of course, a place to pour in the sulphur and an opening for the escape of air.

2. The horsepower of a pulley depends entirely

upon the speed at which it runs and the width of the face. The thing that is usually computed is the horsepower which a belt running on it will transmit. A rough rule is that a belt 1 in. wide, running at 1000 ft. a minute, will transmit 1 h. p., if of single thickness, and 1½ h. p. if of double thickness. To find the speed at which a belt will run on a pulley, multiply the diameter in feet by 3.1416, and this by the number of r. p. m. Thus, a pulley 24 in., or 2 ft. in diameter, running at 100 r. p. m., would have a belt speed of $2 \times 3.1416 \times 100$ or 628.3 ft. If it carried a belt 4 in. wide, then the horsepower which it would transmit would be 628.3, divided by 1,000 and multiplied by 4, or about 2½ h. p. For the horespower that can be taken off a flywheel, the same rule applies as for the line shaft pulley.

Polarity of Trolley Wire

J. H. P.—Our trolley wire is supplied with 500-v. direct current. How can we tell whether the trolley wire is positive or negative? The way we have been testing this is, to take 2 pieces of copper wire and attach on one end of each a piece of flat lead about 4 in. square, and place the squares of lead in a pail of water so that they do not touch each other. Then we attach one wire to the trolley and the other to the rail. In about 20 min. the lead that is attached to the trolley turns brown and becomes thickly coated, while the lead attached to the rail appears to be eaten and turns blue. Now, which lead indicates the positive current, the brown one or the blue? We believe that our trolley wire is positive, and have been operating it this way for 5 years but some electricians seem to think that the blue lead indicates the positive current.

A.—In using the two pieces of lead in a pail of water you will get a storage battery effect. The positive element of a storage battery, consists of peroxide of lead, and is a velvety brown chocolate color, while the negative is a sponge lead of a light gray color. Hardness is also on indication. The positive coating is usually hard like soapstone, while the negative coating is soft, and can be cut into with the thumb nail. In your case the lead attached to the trolley turns brown, and is consequently positive, while the lead connected to the rail turns blue, so it must be negative.

Stand Pipe Pressure; Compound Engines

J. F.—1. What is a standpipe applied to a boiler plant and what is the weight of a pipe 85 ft. high, no diameter given?

2. What is the difference between a cross-compound engine and a triple expansion?

3. How many kinds of engines can a receiver be used on and what kinds?

A.—1. A standpipe in a boiler plant or anywhere else is a tall pipe filled with water for the purpose of creating a pressure. Probably this question means what would a standpipe be for feeding a boiler and the pressure at the bottom of the standpipe if it were 85 feet high and filled with water? The pressure for each foot in depth of a column of water is 0.43 pounds per square inch. Hence, for 85 feet in depth the pressure would be 36.81 pounds.

2. In the cross-compound engine there are two cylinders, the high pressure and the low pressure, located usually on opposite sides of the flywheel and both driving to the same shaft. The compound engine is one in which the low pressure cylinder takes steam from the high pressure and exhausts usually into a condenser. In the triple expansion engine there are three separate expansions of the steam, first in the high-pressure cylinder, from which steam is exhausted into the intermediate cylinder, and from the intermediate cylinder the steam goes to the low-pressure, from which it is carried away to a condenser.

3. The receiver is a vessel to take steam as it is exhausted from one cylinder and hold it for admission to another cylinder. It is used either between the high and low-pressure cylinders of a compound engine, or between the high and intermediate and between the intermediate and low-pressure cylinders for a triple expansion.

Reversing Alternating-current Generators

E. A.—Can the direction of rotation of an alternating-current dynamo be changed, that is, reversed, and will it be necessary to change any of the connections?

A.—Since you do not specify otherwise, we assume that the dynamo is a single-phase machine. If the machine is single phase, there is no occasion to change the connections in reversing the direction of rotation. You will probably need, however, to reverse the position of the brushes on the rectifying commutator, and to change the setting of the brush holder. With these changes the machine should run all right. If the machine is a polyphase, then you will have to reverse the connections of one pair of leads in order to have the phase relation the same after the machine is reversed.

Power of Hoisting Engine

J. W. S.—In answer to your question in the May number of the Practical Engineer as to how the horse power of hoisting engines is obtained, I might submit the following rule, which I came across recently:

To find the theoretical horsepower, multiply the weight in pounds of the load, rope, tackle and other appliances by the speed in feet per minute and divide by 33,000.

To find the operating horsepower 25 to 50 per cent should be added to this result in order to balance the losses due to friction, etc. H. A. Cozzens, Jr.

BRICKWORK IN BOILER SETTING should be carefully looked to, as it is astonishing what a drop in efficiency can be caused by a small leak.

THE HAWKES BOILER

That the water tube and tubular each have certain advantages over the other is generally admitted. The thin heating surfaces, and absence of vitrified joints exposed to the fire, the dividing of the volume of water exposed to the heat into small envelopes, give rapid steaming conditions, being advantages of the water tube type.

The tubular boiler holds a large volume of hot water, giving a large reserve capacity and steady steaming and water line.

The boiler here described possesses the several advantages of each.

The water tube section consists of two rows of water tubes inclined toward the front, the upper row connecting into a saddle at the forward end of the tubular section and into the rear water leg. These tubes are covered with fire brick or tile, preventing the products of combustion coming into contact with the plates of the tubular boiler.

The lowest row of tubes connects into the rear water leg, also into a series of box headers at the front end, which in turn are connected to the front head and water saddle by independent circulating tubes.

The shell of the tubular section is made of flange steel plates, as usual construction for tubular boilers calls for the tubes secured to the heads.

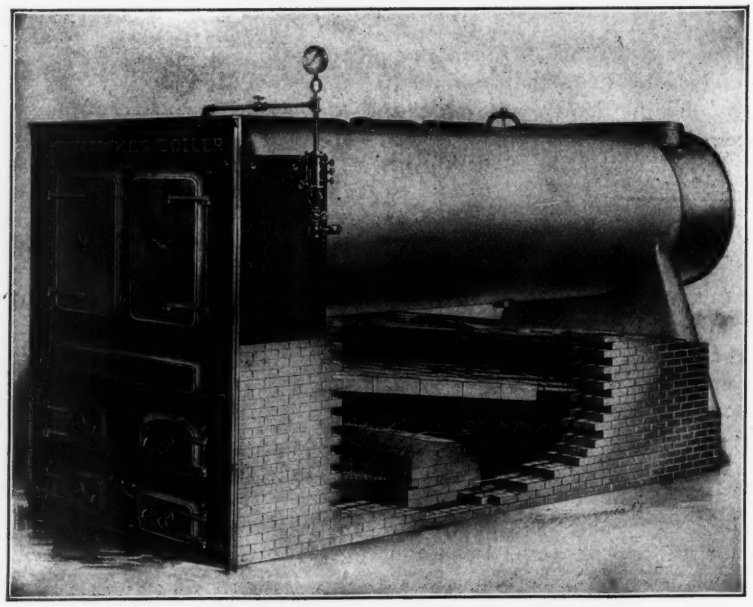


FIG. 1. SECTIONAL VIEW OF SETTING, SHOWING BOILER

The usual manhole and handhole plates are provided for cleaning purposes. Opposite each tube handhole plates are provided for inspection, cleaning and replacing tubes. A type of joint is used on these covers avoiding all forms of packing.

The circulation is positive, ensuring a nearly equal temperature of all parts of the boiler. The front water saddle and rear water leg are made without riveted joints, except where secured to the shell of the tubular section. The water legs are supported by staybolts.

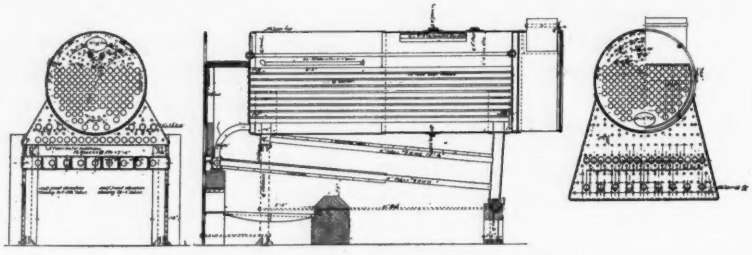


FIG. 2. SECTIONAL VIEWS OF BOILER

The circulation of the water is as follows: The

feed pipe enters the top of shell in the rear, the water descending the water leg in the rear, then forward through the inclined water tubes into the front end of the tubular boiler, which results in depositing the greater part of sediment in this shell, which is the coolest portion of the boiler away from the fire.

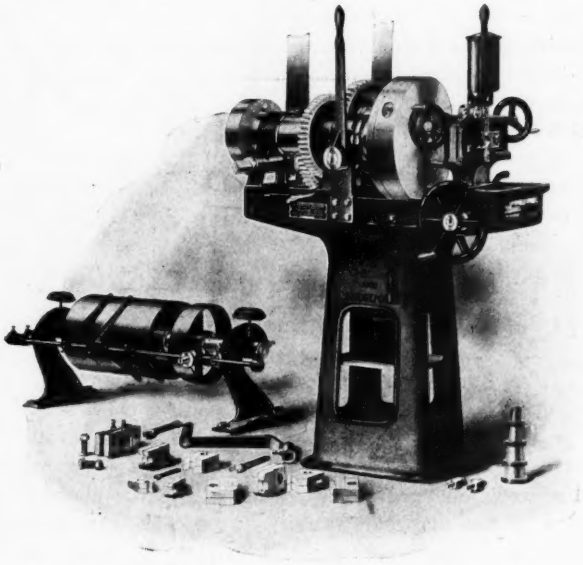
The boiler rests on cast-iron columns beneath the corners of the front water saddle and rear water leg, being supported independent of the brick work.

The Hawkes boiler is made by the Traylor Engineering Co., of New York.

NEW CRANE PIPE MACHINE

This machine is placed on the market to meet the demand for a low-priced machine, operated by hand or power, for high-class service. All parts have been designed to withstand any strains that such a pipe cutting and threading machine may be subjected to. Simplicity of operation, adjustment and arrangement has been carried out to the minutest detail.

This tool possesses many features which increase



CRANE PIPE THREADING AND CUTTING MACHINE

output and facilitate ease of operation. The gripping, threading, cuttingoff and adjustment have been so arranged that no unnecessary operations are required. The frame is a casting, having bed and stand in 1 piece, eliminating the use of light legs and giving great rigidity with minimum weight and floor space.

The die head is bolted to a movable carriage, with ample travel. Upon the die head are pipe guides, cutting-off tool and dies, which are of the improved adjustable type, made collapsible, and similar to those supplied in Crane hand die stocks. The dies are carried in suitable frames sliding in guides, these frames being moved by a screw operated by a hand wheel. The dies are set to gauge by a simple locking device, which allows any number of pieces of pipe of the same size to be threaded without any further adjustment. They have four cutting edges and will give good service on either steel or wrought-iron pipe. Dies are made interchangeable and 1 die of a set may be replaced if broken, thus reducing the repair bill to the minimum. When not in use on the machine, dies may be used on a hand stock. Change in size of dies may be made in a few seconds.

When cutting off the pipe is guided by 2 steel steel guides, hardened on the faces. These guides are operated b ya right and left screw and hand wheel, the cutting-off tool being operated by a lever and rack, which makes a rapid, simple and positive device.

The rear end of the spindle contains a universal centering chuck, compact in design and readily adjusted to the various sizes of pipe. Oil is supplied by a small tank supported on a swivel joint above the die head. A second small tank is placed in the frame, and to this the oil from the dies returns, the supply being controlled by a pet cock.

One pulley is necessary to drive. Three changes of speed are obtained by gears which are shifted by a lever placed on the frame, a device which is positive, simple and cannot get out of order. All machines are supplied with necessary crank for hand operation.

The machine with all needed fittings is supplied by Crane & Co., Chicago, Ill.

A HANDY TOOL SET

Mound Tool & Scraper Co., of St. Louis, whose line of tools for engineers has been well known and highly appreciated for many years, has recently brought out a new set of 20 tools in a convenient case for the use of engineers and electricians. These are all strictly high grade with the good points of tool-smithing carefully embodied in their makeup. The

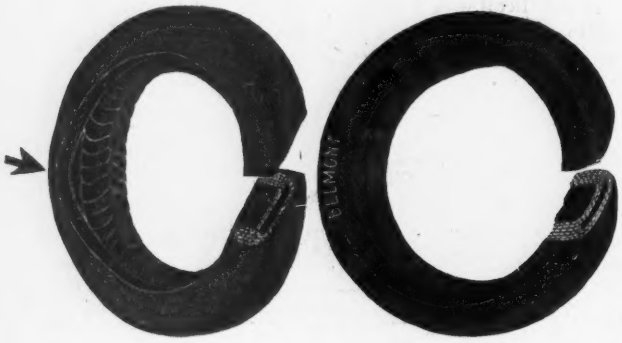
THE MOUND HAND TOOL SET

tools have been chosen with due regard to the needs of the workman and are made to give satisfaction. The set consists of 2 cape chisels, 3 cold chisels, a diamond point chisel, a round nose cape chisel, half cape chisel, sheet metal chisel, a scriber, bent grooving chisel, an oil groove scraping tool, square punch, 2 rivet punches, a nail set, prick punch, center punch, drift, and round point flat chisel.

A STITCH IN TIME

It was somewhat along this line that the Clement Restein Co., of Philadelphia, proceeded in designing their Special Hydraulic Packing. For it is stitched through and through crosswise, in such manner that it cannot be twisted out of its original shape by any movement of the piston or plunger. The advantage of such construction is apparent to every engineer, and is further illustrated by the accompanying cut, which shows a ring of this packing before and after having been stitched.

As may be noticed also from the cuts, this packing is built up around a center or core of finest quality braided flax. Around this, on the 3 sides not touching the rod is a body consisting of alternate layers of cotton duck and rubber with an extra heavy piece



BELMONT HYDRAULIC PACKING BEFORE AND AFTER STITCHING

of rubber near the outside to give great elasticity.

The edges of all these layers are toward the rod, thereby greatly adding to the durability of the packing.

The effect of gland pressure on Belmont Special Hydraulic packing is by compressing its width to increase its thickness, and thus to force the braided flax and the edges of the layers of rubber and cotton duck closely against the rod. This change of form takes place without breaking or in anyway changing the structure of the packing. It is as elastic as rubber, and responds to pressure as a solid piece of rubber would, but without the excessive friction and cost, and with much greater durability.

THE PERFECTION BOILER TUBE WASHER

Every engineer knows how impossible it is to wash the tubes of a water-tube boiler thoroughly with a straight nozzle hose. It is seldom, no matter how much care is taken, that the tubes are clean for more than one-third their length, which results in an accumulation of sediment in the back part, which, sooner or later, becomes so heavy that the tubes are burned out and must be replaced. The Perfection tube washer is not intended to cut scale, but is designed to thoroughly wash out all soft matter and loose scale from water-tube boilers.

It operates on the water turbine principle, as shown in the illustration, with a head which rotates at about

FIG. 1. PERFECTION WATER TUBE WASHER COMPLETE

800 revolutions a minute. The water is thrown on an angle out of the head from two openings and as the hose is passed down through each tube for its entire length, all loose matter is driven before it. Ex-

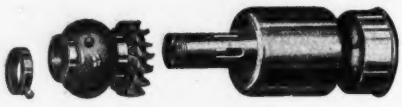


FIG. 2. PARTS OF PERFECTION WASHER

periments have shown that the Perfection washer will take out a large amount of sediment and loose scale even after the tubes have been washed with the straight nozzle.

Thirty pounds pressure is required to drive the machine, which has 1¼-in. standard hose connection. The inventor and manufacturer, E. C. Perry, of 620 Laclede Bldg., St. Louis, has so great confidence in the device that he is offering to send it on 5 days' trial.

A NEW REGRINDING VALVE

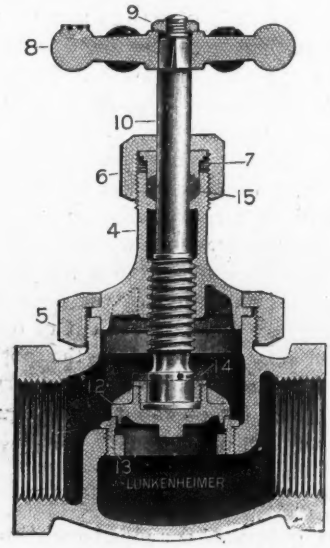
The Lunkenheimer Co., Cincinnati, Ohio, has designed the valve shown in sectional view herewith for the benefit of the trade prefering a renewable seat regrinding valve. This valve differs from the Lunkenheimer regrinding valve only in the construction of the disk and seat. The disk 12 is provided with a projecting ring which enters the valve seat ring 13.

Its principal function is the preservation of the seat, which is accomplished in a two-fold manner. First, as it enters the cylindrical part of the seat it deflects the current of steam from the seat ring face, preventing the wire-drawing which would otherwise occur. This feature is especially important should the valve be left partly open for any length of time. Secondly, the seating surface is kept free from scale and grit by the action of the thin current of steam discharged over it as the disk is brought home. Another function of this ring is the prevention of water-hammer which is caused by the sudden admission of steam. It will readily be seen that no matter how quickly the hand wheel may be operated the flange will permit the steam to enter only gradually.

The seat 13 is renewable, and can be removed from

the valve body by using a flat bar to engage the lugs on the inside of the ring.

This seat may be reground a number of times before it is necessary to renew it. Not only is the seat renewable, but all of the other wearing parts, including the disk, can be renewed if necessary. The hub is securely held to the body by means of a union ring, owing to which it is impossible for the hub and the body to become corroded together, as the thread which holds the union to the body is protected at all times from the action of the steam, the joint being made between the flange on the hub and the neck of the body. This connection also acts as a tie or binder in screwing over the body, and tends to strengthen the valve. The stuffing box can be re-



LUNKENHEIMER REGRINDING VALVE

packed under pressure when the valve is wide open, as a shoulder on the stem directly above the threads forms a seat beneath the stuffing box.

MECHANICAL VALVELESS OILER

The old time method of lubricating engines by separate drop feed oil cups on each bearing, with its consequent uncertainty of operation, the changing of the rate of feed due to temperature changes and the breaking of windows, allowing dirt to find its way into the bearing, have led to the invention of numerous force feed pumps both for bearing and cylinder feed.

A noticable feature of the one here described is the absence of all valves, with their consequent trouble from clogging and liability of being lost when removed for cleaning.

The body is made of brass or steel of any desired capacity and with any number of feeds, which are mounted on top of the body.

Its operation is as follows: The worm A drives the worm gear B and the shaft to which it is secured. Upon this shaft are mounted an eccentric C, giving a reciprocating motion to the rod D that carries the rocker arm E through the eccentric strap X. To one

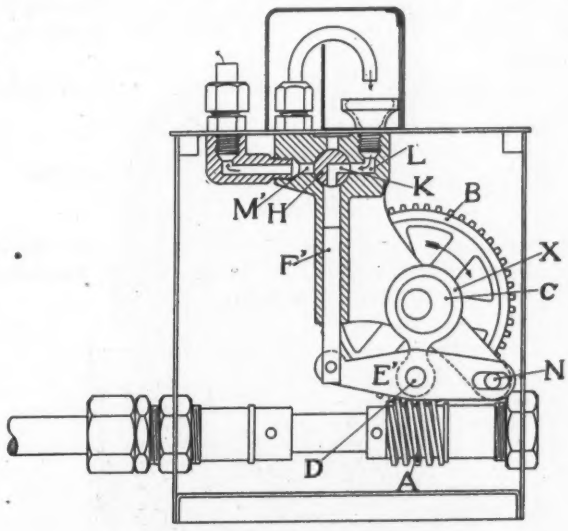


FIG. I. CROSS SECTION OF PUMP

end of the rocker arm E is secured piston F. The crank G is secured to the taper shaft H, and through the connecting rod J a rocking motion is received.

Shaft H has holes in it which on the suction stroke register with the openings L and the piston barrel, and on the forcing stroke with openings M and piston barrel.

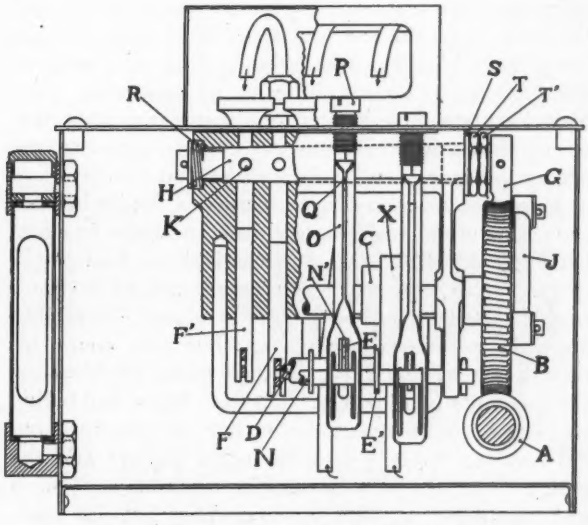


FIG. 2. LONGITUDINAL SECTION OF PUMP

The arrows indicate the direction of flow through the oiler. The volume of oil delivered per stroke is regulated by controlling the stroke of piston F through the amount of lost motion allowed between strap rod N and the regulating piece O and is con-

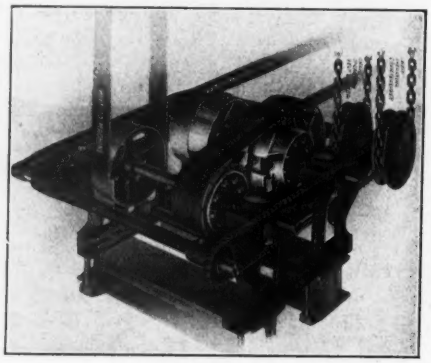
veniently done by turning the regulating screw P, in the cover, which is provided with a positive locking device.

The taper shaft H is provided at one end with the spring R which holds it to its seat. At the other end washer S and locknuts TT hold shaft in correct position.

The makers are the Hancock Mfg. Co., Charlotte. Mich.

THE S. & S. VARIABLE SPEED COUNTERSHAFT

Herewith is illustrated an ingenious device which is being manufactured by the Rotary File & Machine Co., No. 589 Kent Ave., Brooklyn, N. Y.



S. AND S. VARIABLE SPEED COUNTERSHAFT

Every manufacturer knows that there is a leakage in profits through inability to run machines at just the limit speed suitable for each job on hand, but unlike a leaky joint in a steampipe, it does not command attention by constantly showing its existence. Few manufacturers have figured out accurately what this waste represents in dollars and cents. Large as the proportion may seem, it is asserted that this wastage in many instances easily approximates 25 per cent of the yearly profit, which surely makes a means for combatting it worth the careful consideration of all power users. With step cones you cannot get an accurate speed, as the speed required is almost invariably somewhere between the steps, while true cones, although extensively used, are not really practical for the transmission of power. They are heavy and bulky, the strain on the transmission belt is abnormal and destructive; there is no give to the pulleys and the belt, to be of any service must be repeatedly taken up and maintained at high tension. Last but not least, they absorb a lot of power.

The S. & S. Variable Speed countershaft consists of an arrangement of expanding belt operating pulleys by means of which any variable speed relationship desired within the limits of 4 to 1 can be maintained, yet capable of ready adjustment at a moment's notice.

The gear is made in 14 standard sizes, capable of transmitting up to 128 h. p. The variation in the diameter of the expansion pulley is effected as follows: The rim is divided into 12 sections with 2 spokes riveted to each. These spokes slide in machined slots inside a cast-iron hub. Part of each spoke inside the boss has teeth milled on one edge and all are in mesh with a broad pinion. This pinion is operated by an inner shaft which has only longitudinal movement; but owing to grooves being milled on the one end of this inner shaft, any movement given to it rotates the aforesaid pinion inside the hub, drawing the spokes in or forcing them out according to the direction of motion given to the hand wheel which operates both of these inner shafts simultaneously.

Advantages claimed by the manufacturers are, the ability to transmit any amount of power and vary the speed at a ratio of approximately 4 to 1 with little more waste than would be found in two ordinary shafts running together in parallel. Expansion that makes possible an efficient short drive. No expensive special belts are necessary and all pulleys used hung between the bearings, thus only economizing in space but insuring working strains being normal. All gears are adaptable for mounting on girders, ceiling, wall or floor, and the bearings, which are of best phospher bronze, are lubricated from a magazine oil box, which requires the attention of the oiler about once a month. They are most convenient of operation, as the handwheel may be placed in the position most suitable for the operator's requirements. This form of gear can also be operated with equal facility whether in operation or stationary.

SPIRAL RIVETED PIPE

The growing demand for pipe to withstand readily the high pressure now used, also the severe expansion and contraction strains, is readily met by the product

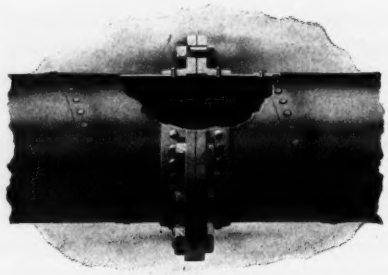


FIG. I. JOINT OF FORGED STEEL FLANGES

of the American Spiral Pipe Works of Chicago, Ill.

Spiral pipe is fully 2/3 stronger and more rigid than the straight seam riveted pipe, due to the absence of horizontal longitudinal seams tending to weaken the pipe. The only seam is a continuous helical one for the entire length of the pipe which forms a stiffening rib of great worth and not being exposed to wear maintains the rigidity of the pipe even though uniform thickness has been considerably reduced by

internal wear. As to the strength of the joint, it has been proved by experiment that the seam is stronger than the plate in all cases. In fact a piece of 12-in. spiral riveted pipe has withstood an internal pressure of 650 lb. per square inch, the metal bulging between the seam 0.75-in., which readily demonstrates

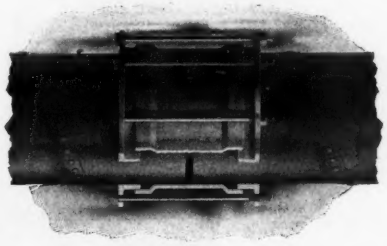


FIG. 2. BOLTED EXPANSION JOINT

that this pipe is much stronger than other types, as this pressure is more than the theoretical pressure for this diameter and thickness.

Two excellent joints for this pipe as made by this company are herewith shown. The flanges are of forged steel, securely and rigidly attached to the pipe by riveting.

To take care of expansion in long lines, the bolted joint with center sleeve is used. This has flanges on both sides and is connected by slipping the flanges over the ends of the pipe, then inserting the ends of the pipe into the center sleeve, placing the rubber packing at each end of the sleeve and compressing it by drawing up on the bolts.

TUBE CLEANER IMPROVEMENTS

Steam users and engineers recognize the fact that the waters available for boiler feed usually contain scale making matter, resulting in decreased efficiency and positive danger of over heating, if not completely removed at proper times.

The selection of a tube cleaner for water tube boilers depends upon the size of tube, whether straight or curved, nature and thickness of scale, pressure at hand to operate the turbine, type and number of boilers, with cost of labor and length of time available for cleaning.

The Lagonda Mfg. Co., of Springfield, O., has brought out a new line of cleaners, described below.

In Fig. 1 is shown a decided improvement, which consists in the use of ball bearings to take the thrust of the revolving parts. Mounted on the spider are swinging arms, which carry the cutter wheels. The arms are drop forged and securely hinged to the slotted arms of the spider, and are free to swing by centrifugal force to the full diameter of the tube being cleaned. There are 4 or more of the arms all alike, one pair preceding the others.

FIG. I. NEW WING ARM WEINLAND HEAD

The cutter wheels are both the star and cone pattern and mounted on steel pins. The forward pair of arms each carry 1 cone cutter in front and 3 star cutters following. The rear arms carry star cutters only.

All these cutters revolve freely on their pins and each pair cuts in a different path, thus removing every particle of scale. The centrifugal force, as the cleaner revolves in the tubes, throws the cutter wheels against the scale forcibly, yet yieldingly, so that the tubes are not injured.

The porcupine head, Fig. 2, with toggle joint, is

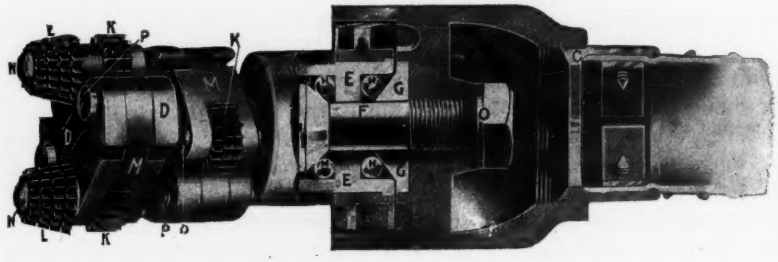


FIG. 3. SECTIONAL VIEW OF WEINLAND CLEANER

FIG. 2. PORCUPINE HEAD.

for removing heavy scale and must be used with the universal joint. This head delivers a light tangential blow which both crushes and knocks the scale. Its blow is sufficiently forcible to remove the scale without injury to the tube.

When the scale is chalky and adheres to the tube the Wing head a Rocker Arm head should be used. Should the scale be brittle and crack off clean, this cleaner alone is sufficient.

The operation of the turbines is as follows:

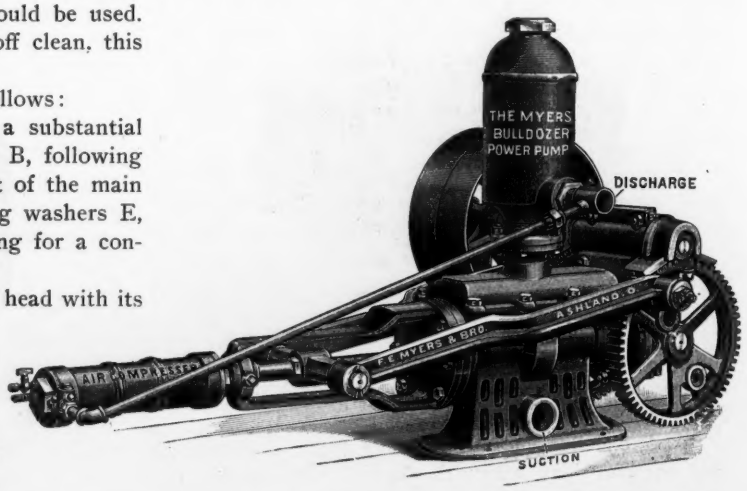
The case is secured to the hose in a substantial manner. The water enters the case at B, following the arrows to turbine wheel C. Thrust of the main spindle S is taken by the thrust bearing washers E, and the spindle is supported in a bearing for a considerable distance, giving strength.

On the end of this bolt or spindle the head with its cutter wheels is mounted. The whole, turbine wheel, spindle head and cutters revolving rapidly. The centrifugal force throws the cutters outward, attacking the scale, and as the cutters have sufficient movement to fill the tube, they remove all the scale.

The water used to drive the cleaner escapes from the case by a suitable opening and flows through the tube, washing the scale ahead and out of the tube

power pumps, with air pump attached, which the maker claims has been operated continuously for 30 days, maintaining an air pressure of 90 lb., operated against a reservoir with a relief valve.

The air compressor shown by the accompanying



HORIZONTAL POWER PUMP WITH DIRECT CONNECTED AIR COMPRESSOR

cut has a brass lined cylinder mounted directly on the yoke guide of the pump, the piston rod of the pump serving as a piston for the air pump. The air is forced directly from the cylinder into the discharge pipe of the pump, through which it is conveyed to the perssure tank. The entire outfit is complete within itself, mounted ready for operation.

All the parts are simple, and substantially built, making a compact, reliable job, performing both functions, viz., pumping the water and the air at the same time, requiring no special fitting or piping of any kind from the erector of the job other than is usual with the ordinary pump.

HYDRO-PNEUMATIC CYLINDERS IN CONNECTION WITH POWER PUMP

The development of air pressure water works systems for residences and other purposes, has been so pronounced during the last few years, and is now so generally understood by the general public, and dealers in water and well supplies, that pumps equipped with air cylinders and air compressor attachments are a part of the business now looked after by the general pump trade.

F. E. Myers & Bro., of Ashland, Ohio, foresaw the condition approaching, and in line with the progressive policy of that concern, began extensive experiments several years ago, with a view of developing a complete line of equipment to fill this coming demand in a way that could be comprehended and utilized by the general pump dealer, realizing that the system of distributing water by air pressure has been tried out to a degree where there is no longer a question regarding its success and advantages, and that the user would naturally turn now to look for the equipment to fill this want.

To meet the demands for the various requirements where pneumatic water systems are being installed, this firm is placing on the market a complete line of pumps equipped with air cylnders, adapted for hand, windmill and power pumps.

The cut illustrates one of the famous bulldozer

EXPERIMENTS of the Forest Service show that with creosoting treatment the life of posts is much increased. When properly treated, such woods as poplar, willow and low grade pine outlast untreated cedar and oak. An open tank outfit for treatment can be installed for $30 to $45 or even less if an old boiler is used; a tank with bottom area of 12 sq. ft. will answer for 50 6-in. posts a day. Creosote costs 10 cents a gal. in the East, 16 cents on the Pacific coast and 27 cents in the Rocky Mountain region. For treatment, one fence post will absorb as follows: Eucalyptus, 0.1 gal.; willow, 0.2 gal.; ash, red oak, elm and maple, 0.4 gal.; fir and black walnut, 0.6 gal.; sycamore, lodgepole pine and cottonwood, 0.7 gal. The cost of treating a post is from 4 to 15 cents and a treated post should last 20 yr. Further particulars can be found in circular 117 issued by the Forest Service from Washington, D. C.

INDIANA ENGINEERS IN STATE CONVENTION

ENERGETIC movement for state license laws is in the air this year, and the Hoosier State is right in line. Consideration of the best means to this end and adoption of a new constitution were the important business features of the meetings. The pleasure of a good reunion and the inspiration of visits to several interesting plants completed the needs for a most successful convention.

Headquarters for the exhibitors and a rendezvous for delegates were maintained at the Oliver Hotel, and meetings of the convention and of committees were held at Woodmen's Hall nearby.

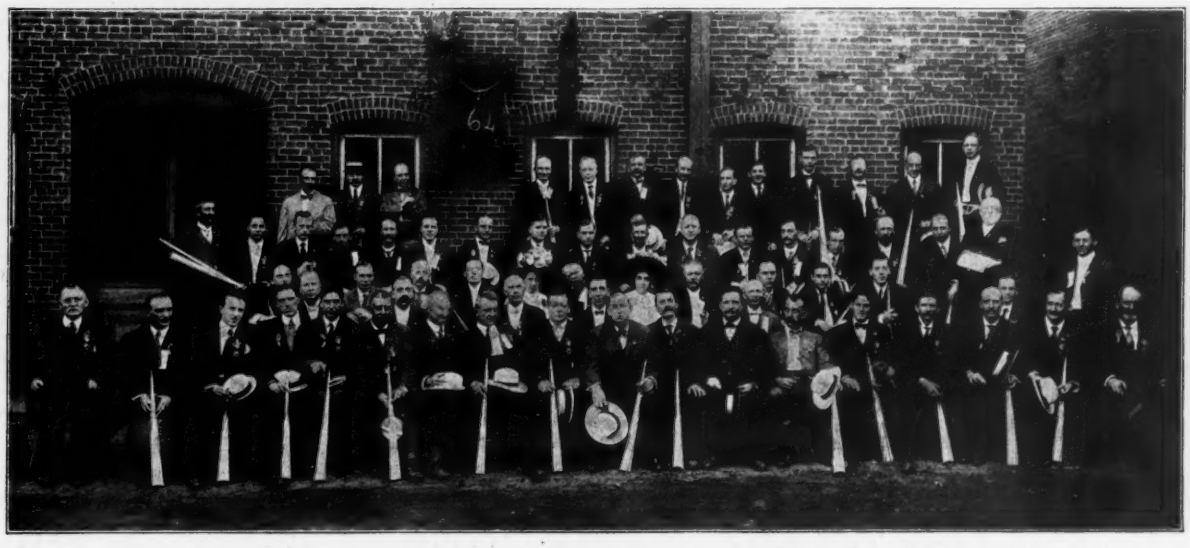
Following the calling to order of the convention by William F. Eger, chairman of the convention committee, the delegates and guests were welcomed with the usual greetings by Mayor E. J. Fogarty, to whom National Secretary Raven replied, giving a short history of the organization. State President Joseph C. Carter also spoke at this time, outlining the growth of the state organization from the time when there were only 6 subordinate associations to the present, when there are 13. Chairman Johnson of the national board of trustees spoke on his favorite topic, and B. M. Knobel, of the Crandall Packing Co., responded to the topic, "Relation of Engineers to Supply Men." After appointment of committees, the session adjourned until afternoon.

At the afternoon meeting the reports of various officers were read and accepted. President Carter recommended an active campaign for a license law and the maintaining of a committee at Indinanapolis during the time when the law was under consideration by the legislature, a levy being made for the necessary expense. Messrs. Heeger and Raven emphasized the need of getting the co-operation of all engineers in the state, and of showing them the advantages to be gained. Also the need of interesting the manufacturers and the public in raising the standard of engineers and securing safety.

Adjournment was taken, to allow of visits to two of the plants, until Saturday.

At the Saturday session, the constitution was taken up, article by article, and adopted, officers were elected and installed and a place of meeting chosen. The usual provisions were made for conduct of meetings, election of officers and their duties. Besides, the following special points were embodied:

Meeting is to be held in June in any town of Indiana where there is a subordinate association, on 2 successive days to be named by the president.



INDIANA STATE ASSOCIATION AT THE PLANT OF THE DODGE MFG. CO.

Delegates are to be elected, 1 for every 25 members or majority fraction, and expenses paid by the association sending them. Special meetings may be called by the president on 30 days' notice.

The president is to appoint committees, authorize expenditures, and is entitled to expenses needed in conduct of his office.

A transportation committee and a hotel committee, each of 3 members, are to be appointed 3 months before the annual meeting.

Secretary and treasurer are each to give bond of $250, and are to report to the president quarterly as to receipts and expenditures.

State officers must be elected as delegates by their respective associations.

Fifty cents per member may be levied on each

subordinate association to provide an expense fund for license legislation. The per capita tax for general expense to be 10 cents.

Officers elected were: President, George O. Harris, of Evansville; vice president, William C. Pearce, of Terre Haute; secretary, Charles Striethof, of Evansville; treasurer, William H. Tupper, of Mishawaka; conductor, H. E. Smith, of Terre Haute; doorkeeper, Levi Crater, of Edinburg. The place of meeting selected for 1909 was Indianapolis.

A pleasant feature of the closing session was the presentation to Past President F. W. Headson, Lafayette association, of a jewel of that office.

Entertainments

Relaxation was mixed with labor. Friday afternoon brought a special car for a ride to the plant of the Dodge Mfg. Co., at Mishawaka, where a trip was made through the big plant to find out how pulleys and rope drives are made. The making of big wooden pulley rims, long transmission of power by rope, how to serve delicious punch, were some of the special things learned. And for remembrance, a handy belt calculator and a group photograph taken at the plant were furnished to each one of the party.

From here to the water power plant of the Twin Branch Power Station was a pleasant ride, enlivened by the Crandall Amateur Band and by Arens and Heeger in their great specialty, "The Heavenly Twins."

At the Twin Branch station rest and refreshment were found and a fine plant, having 4 units of 1,500 kw. each under a head of 22 ft. and room for 2 more units. The power is transmitted to Elkhart, South Bend and Mishawaka.

On Saturday morning the immense plant of the Studebaker Wagon Works was inspected, and all kinds of vehicles seen in the course of construction. Thousands of frames, wheels and bodies were found on the way from stock yard to storage house, and it seemed as if with this great factory turning out such a large quantity that in South Bend "even beggars might ride."

An afternoon trip to educational centers, an evening of social jollity, and a trolley ride to Berrien Springs and St. Joe, Mich., on Sunday completed the entertainment features.

Exhibits and Exhibitors

Contributing to the interest as well as the expenses of the convention by the exhibits arranged for the instruction of delegates were the following firms: Central Supply Co., Indianapolis;; Arrow Boiler Compound Co., St. Louis, which furnished "singers" for the meetings; Adam Cook's Sons Co., New York; Dearborn Drug and Chemical Co., Chicago, represented by Mr. Hall; Greene, Tweed & Co., New York; Lagonda Mfg. Co., Springfield, O., represented by F. S. Davidson; Jenkins Bros., Chicago, represented by Albert T. Arens; Green Engineering Co., Chicago; Quaker City Rubber Co., Philadelphia; Crandall Packing Co., Cleveland, represented by B. M. Knobel and C. M. Chapman, and who furnished "the band"; Keystone Lubricating Co., Philadelphia; The Lunkenheimer Co., Cincinnati, represented by Clarence G. Strong; Wm. W. Nugent & Co., Chicago, whose catalogs were especially attractive; Power, represented by O. Monnett; Dodge Mfg. Co., Mishawaka, Ind., represented by W. H. Tupper; Homestead Valve Mfg. Co., Pittsburg; Union Steam Pump Co., Battle Creek, Mich.; South Bend Supply Co., represented by C. H. Dunfee; Practical Engineer, Chicago, represented by Arthur L. Rice; Wickes Boiler Co., Saginaw, Mich.; Standard Oil Co., South Bend, represented by E. J. Harrison; Hawkeye Compound Co., Chicago, represented by H. E. Tibbles and W. F. Ebert; H. W. Johns-Manville Co., represented by F. W. Davis, of Indianapolis; Garlock Packing Co., represented by A. H. Carr, of Detroit, who furnished handsome leather note books and pencils; Taylor Steam Trap Co., of Battle Creek, Mich., represented by J. H. Taylor.

Besides these the goods of the following firms were presented by the South Bend Supply Co.: Ryan Steam Traps, Wright Improved Safety Water Columns, Victor Balata Belting, Scully Everlasting Blowoff Valve, Martin Anti-friction Rocking Grates, Burnham Steam Pumps, Kewanee Flange Unions and High Duty Metal.

OHIO ENGINEERS IN STATE CONVENTION

JUNE 18-20, AT SPRINGFIELD, O.

ALTHOUGH the interest of the entire country, and Ohio in particular, was concentrated on Chicago, it did not in the least detract from the smaller but quite as enthusiastic convention at Springfield.

Delegates met at 10:30 on Thursday morning at the call of W. F. Koontz, chairman of the local committee and, after invocation by Rev. E. H. Dornblaser, were welcomed to Springfield by Mayor W. R. Burnett, who sketched the advance of engineering since the early days when he served as machinist and a negro divided his time between sweeping up, breaking castings and tending engine.

President H. H. Forney, in a brief speech, expressed the thanks of the meeting for the welcome and the work of the local committee.

Addresses by several brothers followed: John A. Kerley emphasized the fact that the success of engineering societies are founded on education; that the associations need the support of every member, and that in order to further their interests as stockholders,

all members should write to advertisers in the official organ for catalogues and information.

National State Deputy Frank Yeager told of the growth of the state convention from 12 to 45 delegates in 1 year because of the passage of the state license law, and of the 25 per cent increase in wages in 12 years, due to this law. He also urged secretaries to attend to their duties or resign office, and all members to try for steady advance in their knowledge and value.

Herbert Stone, speaking of license laws, called attention to the advantage of the Ohio provisions and urged the effort of engineers to get to something higher than turning a throttle and oiling bearings; to look for the big positions which involve management of men. He called attention to the requirement of license in some form for the practise of most callings where special knowledge is needed or human life involved and deprecated the attitude of some engineers that their calling should not be so treated.

Judson Pratt gave a general appreciation of the work of the associations throughout the country and urged the adoption of the red, white and blue badge.

Dan Delaney told several stories which were greatly appreciated and asked the support of delegates for Columbus, O., for the national convention of 1909.

Columbus Dill spoke briefly on the work of associations.

After appointment of committees, the meeting adjourned until afternoon.

At the afternoon session, reports of officers and committees were received and referred or accepted. The two matters of most interest were the resolution against the making of the state examination board for engineers bipartisan, and the one endorsing a law requiring boiler inspection throughout the state. These were taken up further on Saturday and after full discussion were passed.

Officers were elected as follows: President, E. C. Johnson, No. 5; vice-president, George Arnold, No. 3; secretary, Charles M. Gilbert, No. 38; treasurer, Volney Weatherhead, No. 36; conductor, J. R. Hazel, No. 42; doorkeeper, W. L. Teik, No. 28.

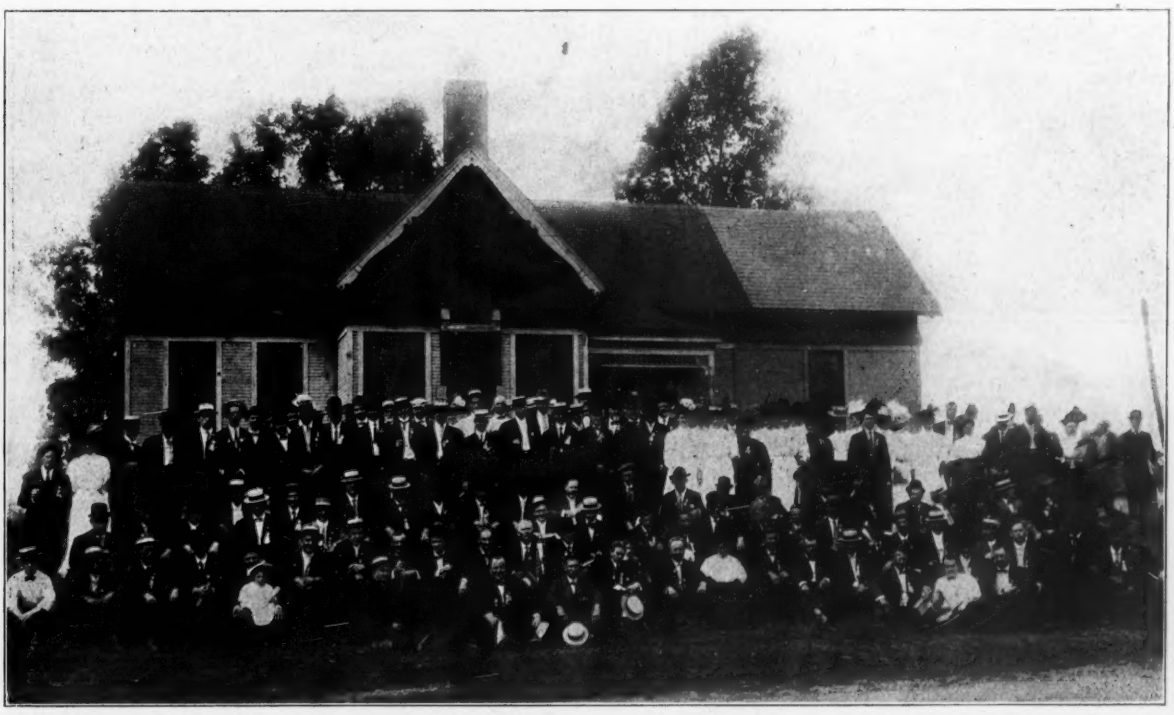


FIG. I. DELEGATES AND FRIENDS AT OHIO STATE CONVENTION AT OFFICE OF HOPPES MFG. CO.

Place of meeting selected was Columbus, the session to be held at the same time as the National, if that meets in Columbus; otherwise to be held in June.

Excursions

After the session on Thursday those present were taken to the local lighting plant to see the Hoppes feed water purifier used there in actual operation. Friday all day was given to trips about the city. In the morning the plant of the Hoppes Mfg. Co. was inspected and engineers were presented with a fine 3-in. Starrett steel scale in leather case. Here the interest of many visitors was attracted by pneumatic riveters used in making up steel shells for the heaters and by the new type of purifier with cast-iron interchangeable trays. A photograph of those in attendance was taken at this place.

Then the party was taken to the plant of the Lagonda Mfg. Co. to see how the Weinland tube cleaners are made. Mr. Bradley, president of the company,

greeted the guests, who saw the entire workings of the factory, including the operation of the new air motor and the construction of the new wing head cleaner. Refreshments were served and key chain souvenirs distributed. The rest of the morning was Odd Fellows' homes, which are two of the show places

LUNKENHEIMER BRASS SPECIALTIES, including valves, whistles, lubricators, oil cups, etc., were exhibited in convenient form for inspection on a pipe framework. Herbert R. Wunder supplied visitors with attractive "hand and valve" watch chain charms, much to their satisfaction.

FIG. 2. EXHIBITS OF ADAM COOK'S SONS AND THE LUNKENHEIMER CO.

of the city. In the afternoon the entire party was taken by trolley to Spring Grove Park, where it was entertained with the usual devices of amusement parks and with a special feature, the diving horses.

HOPPES MFG. CO. in a big space on the platform showed an especially interesting set of trays taken from the local lighting plant purifier after 3 weeks run. These were coated with scale to a depth of 2 in. or more and

FIG. 3. HOPPES MFG. CO. AND LAGONDA MFG. CO.'S BOOTHS

Friday evening was occupied with a lecture on The Steam Boiler, by Royal H. Holbrook, which was well worth the careful attention of all interested in power plants.

EXHIBIT NOTES

ALBANY GREASE, made by Adam Cook's Sons, was represented by G. E. Tanberg, of New York. Samples of grease and sample grease cups made up the exhibit, and handy pocket pencils were the souvenirs.

showed particularly the value of the under side of the pans in collecting the sediment. Vertical and horizontal oil and water separators were shown, both sectioned and complete, ready for use. Also butterfly valve, regulating valve and float box for the Hoppes heaters. J. J. Hoppes, president of the company and J. F. Ware, general representative, were in charge, and Charles Hoppes was with the bunch.

WEINLAND TUBE CLEANERS, with the new wing head,

were the feature of the Lagonda Mfg. Co. booth. All machines of this company are now supplied with this head, which is shown in detail and described on page 67. Also was shown the new air and steam motor described in the June issue, page 64. The booth was surrounded with a frame on which a line of cleaners was mounted, which were kept in motion by a motor and rope drive. Other features were a tube cap cleaner for water tube boilers and a big non-return double automatic valve. H. F. Weinland, Herman Weinland, M. M. Sellers and E. E. Haur represented the company, and Charles C. Bradley, president of the company, attended some of the sessions.

FIG. 4. GREENE, TWEED & CO., KEYSTONE GREASE CO., CRANDALL PACKING CO., GEO. W. LORD CO., AND STRONG, CARLISLE & HAMMOND CO. DISPLAYS

PALMETTE PACKINGS in coil and twist, and the bright red label made the space of Green, Tweed & Co. notice-The Favorite reversible ratchet wrench was also shown by B. M. Bulkley in charge, and the Greenet gasket tubing with metal center for manhole gaskets.

GEORGE W. LORD & Co.'s boiler compounds and Edward McCarthy are one and inseparable. The booklet on Boiler Scale; Its Formation and removal, which was handed to delegates, is full of valuable data for those who will read it and think. The Lord key chain was also a gift to be appreciated by those who received it.

STRONG, CARLISLE AND HAMMOND made a most interesting showing of the Squires' steam specialties, including feed-water regulator, reducing valve and pump governor, and of the Winter's traps for vacuum and pressure. Homer Whelpley was "it" for the company.

GARLOCK was the single word to indicate the place of the Garlock Packing Co. C. J. Carr and F. G. Breiner "kept house" there and had interesting samples of braided copper rings for the bottom of boxes which are large for the rod, regular ring packings of either asbestos backed by rubber friction or friction with rubber cushion, rubber tubular, moulded and cut gasket, rod packing for hot

FIG. 5. GARLOCK PACKINGS, JENKIN'S VALVES AND ARMSTRONG GRATES

KEYSTONE GREASE was well pushed by L. L. Lacy. Cans of the material, sample cups and caps furnished gratis were the materials used for pushing the grease.

CRANDALL PACKINGS, made for all purposes, Regina red sheet, Kynior black sheet, spiral rod for high and low pressure, flat for marine use, Helios gaskets and rings for high pressure, red tubular and pump valves were shown and calendar paper clips furnished by J. M. Chapman, W. D. Callinan and A. M. Beadle at the Crandall Packing Co. booth.

and cold water and ammonia, section ring, tubular gasket of rubber and asbestos over a lead tube and air packing of asbestos with flax core. Souvenirs given by the Garlock Packing Co. were cigar cutters, card cases, pass books and handsome watch fobs.

JENKINS VALVES, Jenkins 96 packing, pump disk valves, and gasket tubing were the things of which a most interesting exhibit was made up, the whole being in charge of J. T. Bulkley of the Philadelphia branch of Jenkins Brothers

H. W. JOHNS-MANVILLE Co. showed a line of J.-M. packings of asbestos, flax, rubber friction and impregnated fabric, in round, square, sheet and molded forms for rings and gaskets. Samples of pure asbestos in crude form were distributed by Messrs. H. W. McKinley, E. E. Skinner, Cotton Mather, Mike O'Brien and H. A. Wilson, at the booth. A celluloid ruler served to remind the engineers of Magic methods of scale removal.

THE WM. POWELL Co. exhibited a line of brass and iron steam engineering specialties, among them the Titan and Giant quick closing gate valves and White Star stop valves, which were symbolized by the gilt star watch charm given to delegates. Michael F. Brenner was in charge of the exhibit.

W. S. CUSHION was present in the interests of the Southern Engineer.

A. M. SWINDLER represented the Arrow Boiler Compound Co. and kept things lively with whistlers.

F. H. LANGLEY, of the J. H. Parsons Chemical Co., explained how his company applies "Chemistry to the Care of Boilers," and distributed "curtain badges."

V. D. ANDERSON Co. was represented by Jos. H. Meyer. The Anderson Improved steam trap and special forms of extra strong floats for high pressures were shown. Visitors received a pocket book of Handy Dater.

CLING SURFACE, what it is, what it can do, how it is to be used, were in the story told, illustrated and proved at the Cling Surface Co.'s quarters by H. V. Brown.

MOFFAT FEED WATER HEATERS and purifiers were shown as to construction by a sectional model. Mr. Moffat and his son were present from the new office at Dayton, O., of the Moffatt Feed Water Heater and Purifier Co., whose combination pocket device was a "taker."

EDGE-ON LEATHER BELTING and Victor Balata waterproof belting were the features of the exhibit of Regal Belting Co. The Edge-on is made of strips sewed together so that the edge runs next the pulley, thus making it flexible, durable and a great puller. L. A. Bodie served as information bureau about this belting.

DEARBORN COMPOUNDS were advocated by Dan Delaney. He gave interesting mementoes such as puzzle cards, a calendar, pencils and a mock cigar.

OSBORN MONNETT, Fred Low and F. S. Fugate represented Power.

HAWKEYE COMPOUND Co. helped to make merry and comfortable. Its souvenir fans relieved the distress of the heat and its "deviline chorus" was a joy to the populace on Friday. In its interest were present, H. E. Tibbles, F. S. Dodge, W. F. Ebert and Wm. Wiotte.

W. C. ARMSTRONG showed for the Armstrong Mfg. Co. a new shaking grate which gives large air space and breaks up clinker. In the same section were a new flue blower and a steam trap exhibited by Mr. Lambert.

Firms represented but not exhibiting were: Buckeye Engine Co.; Valvoline Oil Co., by Judson Pratt; Chapman Valve Mfg. Co., by Herbert E. Stone; Detroit Stoker and Foundry Co., by E. H. Lostetter; Dayton Steam Boiler Works; and W. M. Pattison Supply Co., by L. J. Murray; Liberty Mfg. Co., represented by Mr. Conn; Bradford Belting Co., represented by A. Shwarts, who favored friends with handsome watch fobs.

WISCONSIN CONVENTION AT MILWAUKEE

The 8th annual convention of the Wisconsin State Association of the N. A. S. E. was held at Milwaukee June 19th and 20th, at the Blatz Hotel.

The meeting was called to order by John A. Wickert, chairman of the local committee, who then introduced Mayor Rose. The mayor stated stationary engineering, in his opinion, to be one of the most important professions in the world, and extended the hospitalities of the city.

To this address, National Secretary F. W. Raven responded, on behalf of the visiting engineers, in his usual humorous way.

Prof. Louis E. Reber, of Madison, Director of University of Wisconsin, spoke on the topic, "What the University is Doing for the Engineers," to which John W. Lane, editor the National Engineer, responded.

State President Lawrie thanked the officers for their support during his year of office, and took charge of the convention.

In the afternoon the reports of the various committees and officers were read and accepted.

The state education committee was thanked for its very efficient educational work during the year. The association will work for a state license law.

Bro. Fulmer, of Oshkosh, gave a talk on "Some Principles of Refrigeration."

The officers elected for the year were: President, Chas. Oswald; vice-president, A. Balzer; secretary, H. I. Maitland; treasurer, F. Ruck; conductor, F. H. Smith; doorkeeper, F. A. Austin. National Secretary Raven installed the officers.

Thursday evening a reception was tendered the delegates and guests in Hotel Blatz. Friday morning the delegates visited the Vilter Mfg. Co. plant, where lunch was served and picture take. The visitors also inspected the Schlitz Brewery and main power house of Milwaukee Street Ry. and Lighting Co. Saturday electrics conveyed the party to the National Soldiers' Home, where a picture was taken, and to Washington Park.

Saturday evening the delegates attended the Majestic theatre. Sunday the delegates visited Blatz Brewery; special electrics took the visitors to Allis-Chalmers' plant, where lunch was served. Sunday afternoon the delegates and guests went to Wonderland.

Other firms contributing were: Vilter Mfg. Co.; Hawkeye Boiler Compound Co.; W. D. Halsted Oil Co.; Standard Oil Co.; Milwaukee Western Fuel Co.; Independent Oil & Grease Co.; Garlock Packing Co.; Greene, Tweed & Co.; Geo. F. Rohn Co.; Wadhams Oil Co.; Blomkun Electric Co.; McMaster Carr Supply Co.; O'Neil Oil & Paint Co.; O. L. Packard Co.; F. Spinkman & Son; Geo. J. Meyer Mfg. Co.; Manthey & Sieker; Quaker City Rubber Co.; Chapman Valve Co.; National Machine Co.; Downey & Kruse; Power and the Engineer; E. Eldred Magie; Wm. W. Nugent Co.; Fred W. Weis; National Blower Works; Julius Andrae Co.; Diamond Power & Specialty Co.; Grassler & Gezelschap; Sheriff Mfg. Co.; L. A. Meyer & Co.; Otto E. Schmidt; The Phillip Schwab & Anderson Co.; Northwestern Fuel Co.; The Lagonda Mfg. Co.; The Keasbey & Mattison Co.; Diamond Compound Co.

Those exhibiting were:

Hills McCanna Co., who exhibited their well-known oil pump lubricators.

The Henry Steam Flue Cleaner Co. had one of their cleaners on exhibition and were represented by Wm. Neuman.

Jenkins Bros. showed their extensive line of valves, packing, etc. Represented by H. B. McLelland.

Peters Oil and Compound Co., represented by P. H. Peters.

Dearborn Drug and Chemical Co., represented by Elborn T. Ward.

Lunkenheimer Co., Cincinnati, O., showed their extensive line of steam specialties, and was represented by Mr. Johnson.

Crandall Packing Co. showed their well-known packings, with B. M. Knobel in charge.

The Johns-Manville Co. showed their extensive line of asbestos packings.

The Poe-Stephenson showed the Scott line of valves.

Adam Cook's Sons Co. showed the well-known Albany grease, and was represented by Mr. Cook.

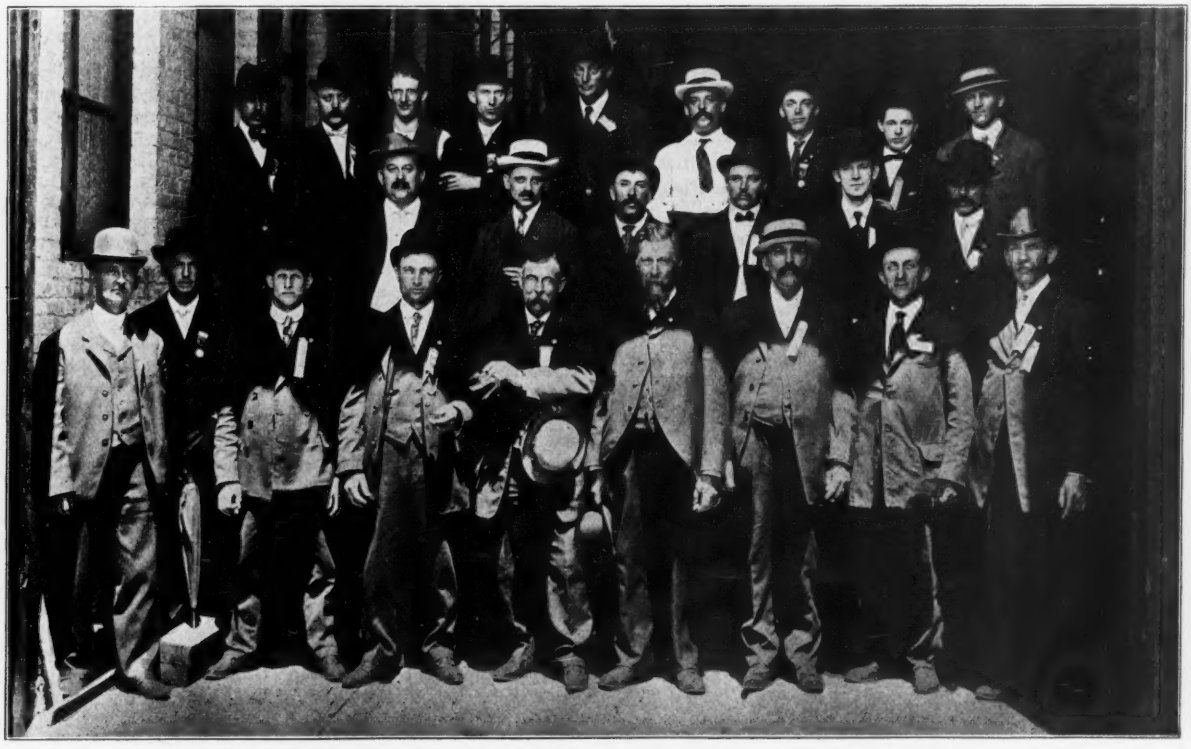


FIG. I. DELEGATES AT PLANT OF VILTER MFG. CO., WISCON SIN STATE CONVENTION

PITTING IN STEAM CYLINDERS

An instance of trouble in the above line was encountered in a large power plant with which the writer is familiar. The facts of the case were as follows: The installation consisted of three 72-in. by 16 ft. return tubular boilers; two 18 by 42-in. Corliss engines, which were developing together 325 h. p.; two high speed engines used for lighting, one driving a 20-k. w. generator and the other a 6.5-k. w.; one fan engine used for heating purposes. The first difficulty was that the cylinders and valves were found to be wearing very much—more than normal conditions would warrant—and it was found to be impossible to prevent this wear by any amount of lubrication, although oils of the very best lubricating qualities were used.

There was also pitting on the bottom of the cylin-

der, apparently from the water striking at this place. The deepest of these pits were found to be in the clearance space between the piston and cylinder head, which was ¼ in. This pitting extended more or less into the cylinder in a triangular form of say about 6 in. at the base and 10 in. or so at the apex.

Many causes were suggested for the trouble, among others was that of acid in the cylinder oil, but the oil was tested and no trace of acid found, and further, the same oil was being used on the other engines, pumps, etc., and no such conditions were produced in any of them. So it would appear to be some other cause than oil. The writer has asked a number of engineers of long and varied experience, but could not find any one of them who had seen similar conditions brought about by cylinder oil.

Several oils were tried, but it did not change the conditions. Then it was attributed to the compound used in the boilers, it being claimed that acid must be in this and that it was carried over with the steam, but the compound was tested in a like manner for acid, and none was found.

The plant in which the power house is situated is a wood working concern, and the shavings from the machines were automatically fed to one of the boilers; the others used coal. It is claimed by the writer that the whole cause of the trouble was the result of priming or foaming of the boiler that was fed with the shavings, and it was suggested that these shavings be divided and part fed to each of two boilers to equalize the firing. Again it was claimed by a man who was supposed to be an expert, that a boiler that was being supplied with muddy water would not foam unless required to supply more steam than could be evaporated without crowding. The writer claims that a boiler will foam with muddy water regardless of the demand made upon it, and has proved this time and again. The clay or mud with which the water is impregnated contains alkaline matter which produces the foaming. One does not need a steam boiler to demonstrate this. It can be proved by an open vessel placed upon a stove. H. I. M.

IN A PAMPHLET ISSUED by the University of Illinois Engineering Experiment Station are given the results of a series of tests on a liquid air plant now installed at the university. The series covers a wide range of conditions, but the conclusions may be reduced to simple terms. In the matter of energy, it was found that only 2.5 per cent of the energy expended in producing the liquid air is available for doing work. At a cost of 8 cents a kilowatt-hour for power and an attendant at 35 cents an hour, with the plant running at 3,000 pounds pressure and the temperature of the air entering the liquifier at the freezing point, the cost of the liquid air is 22 cents a pint. With a pressure of 2,500 pounds and a temperature of 59 degrees F., the cost would be 32 cents a pint. The full record of results can be obtained in Bulletin No. 21 of the university.

NEWS NOTES

THE OFFICES AND WORKS of The Hadaway Electric Heating & Engineering Co., which was some time since acquired by the Westinghouse Electric & Manufacturing Co., have been removed from 238 West Broadway, New York, to the works of the Electric Co., at East Pittsburg. This change will permit the business to be carried on upon a much larger scale than formerly and all the standard appliances for hatters, confectioners, printers and other manufacturers will be turned out in larger quantities. Special attention will be given to the manufacture of the sad irons, glue pots and similar appliances that have recently become so popular.

A New York office will be maintained on the 22nd floor of the City Investing Building, 165 Broadway.

PLANS AND SPECIFICATIONS for a new power house for the Bigelow Carpet Co., Clinton, Mass., have been completed, and bids called for by Charles T. Main, mill engineer and architect, Boston. They include power, boiler and pump houses, stack and coal pocket, and contemplate an installation of over 2,500 boiler horsepower, and about 1,100 kw. in generating sets.

ELECTRIC TRACTION WEEKLY, formerly published in Cleveland, has removed to Chicago, and now has offices in the Manhattan Building. The first issue was mailed from Chicago June 18.

AMERICAN STOKER CO. has removed its works from Erie, Pa., to Monongahela, and in future the general offices for business management and sales will be in the Park Building, Pittsburg.

IN ITS NEW PLANT, which is to be erected at Manchester, across the James River from Richmond, the Glacier Metal Co., of Richmond, will use a number of melting furnaces for the manufacture of brass, babbitt metal, etc. The company is now in the market for such furnaces and is especially anxious to get information in regard to reclaiming metal from waste such as old cans, etc. The expectation is to use pots containing from 1,000 to 2,000 pounds each.

A. L. IDE & SONS, Springfield, Ill., have put out a handsome pack of playing cards having illustrations of the new Ideal side crank engine on the back. These are a fine quality of playing cards and may be had by anyone on receipt of 25 cents in stamps.

JOSEPH T. RYERSON & SON have completed new general offices and warehouse at 16th and Rockwell Streets, and have discontinued the Milwaukee Avenue and Lake Street offices. Branch offices are maintained at the Commercial National Bank Building in Chicago, with hourly automobile service from the branch office to the general offices until evening hours, beginning at 8 o'clock in the morning, an innovation which will be found of great convenience to patrons of the company.

AT THE ANNUAL MEETING of the Joseph Dixon Crucible Co. on April 20, the old officers were unanimously re-elected: President, Edward F. C. Young; vice-president, George T. Smith; treasurer, George E. Long; secretary, Harry Dailey. The board of directors were chosen as follows: The officers already named and Messrs. William Murray, Edward L. Young, and William H. Corbin.

ALLIS-CHALMERS CO. has opened an office at Birmingham, Ala., in charge of Seldon Jones, as district manager, rooms 319-320 First National Bank Building. Inquiries regarding the varied line of machinery manufactured by the company will be promptly attended to at this address.

BATES MACHINE CO., of Joliet, Ill., has opened a sales office at 423 Land Title Building, Philadelphia, of which W. E. S. Dyer will be manager.

R. D. NUTTALL CO., of Pittsburg, has established a new department, to be devoted exclusively to the manufacture of gears and pinions for air compressors. This company has for some time been supplying gears and pinions for all standard makes of air compressors. It is owing to the rapidly growing demand for compressed air in a number of important industries that a special department was found necessary.

H. W. JOHNS-MANVILLE CO., of New York, has opened a branch office in Indianapolis, Ind., to take care of the local requirements of the trade in that territory. This office, which is located at 30 South Pennsylvania St., will be under the management of Charles E. Wehr, who for several years has represented the company in that section.

EXAMINATION WILL BE HELD for the position of engineer in the United States Mint at Denver, Col., on July 8. Application blanks can be had from U. S. Civil Service Commission, Washington, D. C. Form 1600 and Application Form 1093 are the ones needed. Examination will be on letter writing, practical questions and experience. The examination is open to all citizens of the United States except those afflicted with tuberculosis. The pay is $4.25 a day.

EXAMINATION WILL BE HELD on July 22 to 24 in various cities for electrical engineer and mechanical draftsmen in the U. S. Reclamation Service. The salary at the start will be from $100 to $200 a month. Examinations will cover mathematics, hydraulics, theory and practice of electrical engineering, steam turbines and engines, drawing and design, and experience. The first three subjects will be given on the 22nd, fourth and fifth subjects on the 23rd. Competitors may also be examined on centrifugal pumps, turbine water wheels and gas engines; these subjects to be given on the 24th. Requirements are that an applicant must have had at least 8 years' experience on electrical engineering work, must be 25 to 45 years of age, and must file application on Form 1312, to be obtained from the U. S. Civil Service Commission, Washington, D. C. Applications must be filed at Washington before July 11. Applicants must provide their own drawing board and instruments for the examination.

UNIVERSITY OF WISCONSIN opened its summer courses on June 22 for a period of 6 weeks. Work is offered in various departments on chemical engineering, electrical engineering, hydraulic engineering, steam and gas engineering, mechanical drawing and machine design, mechanics and testing of materials, and shop work. In addition to the regular engineering courses the summer school offers courses of the more elementary type on most of the subjects mentioned, these courses being adapted to students who have had common school training and some practical experience. Further information can be had from F. E. Turneaure, Madison, Wis.

PERSONAL

WALTER B. SNOW, publicity engineer, has recently increased his facilities by removal to larger quarters at 170 Summer Street, Boston, Mass., and the establishment of an addressing and mailing department in connection with which select mailing lists will be maintained for the special use of his clients.

H. B. MACFARLAND and V. Oldberg have established an office for consulting engineering work at 358 Dearborn St., Chicago, under the name of the Gas Motor Testing and Engineering Co. They will specialize on producer and gas engine work, for which their long study and experience especially fit them. One specialty already developed is the Oldberg muffler for gas and gasoline engines. This is designed so as to silence the exhaust entirely, but the openings are so designed as to give free expansion and bring no back pressure on the engine.

PROFESSOR WILLIAM KENT, who for 5 years has held the position of Dean and Professor of Mechanical Engineering in the College of Applied Science, Syracuse University, has terminated his connection with that institution. He made a good fight for the safety of the students under his care, refusing to be silenced in his condemnation of one of the buildings which, as it was used, was an unsafe fire trap. While the narrowness of the trustees would not let them see the faithfulness of Dean Kent's service, spite of the fact that his position and action were endorsed by the fire department of Syracuse and the Underwriter's Board, he has the satisfaction of knowing that the press of the country, both technical and popular, are approving his stand. He will devote a year to writing and the revision of his "Mechanical Engineer's Pocket Book" and "Steam Boiler Economy" and will also be open for professional engagement.

W. J. A. LONDON has recently accepted the position of chief engineer of the Terry Steam Turbine Co., Hartford, Conn., succeeding C. E. Terry, recently deceased. Mr. London's experience in the turbine industry has been extensive, dating from his early connection with the C. A. Parsons Co., Newcastle, England, and about 15 years later with Brown-Boveri Co., Baden, Germany, the British and American Westinghouse Cos. His work has taken him into the field not only of land turbines, turbo-generators and condensers, but also that of marine propulsion.

SOCIETIES

AT THE DENVER CONVENTION of the N. A. S. E., Sept. 7 to 12, Monday will be devoted to greeting of delegates and an evening reception. Tuesday will be the opening of the real convention work and the exhibit of the National Exhibitors' Association. Wednesday will be given up to all-day excursion to Silver Plume. Thursday will be regular convention work supplemented with an evening theater party; Friday, the closing sessions and a grand ball in the evening. Saturday excursions will be made to Colorado Springs, Cripple Creek and other points. Summer tourist rates will be granted on practically all lines, the tickets being good from July 1 and returning until October 31. It is expected that 2,000 delegates and guests will be in attendance besides those from the mountain states. It will thus be a fine opportunity to get acquainted with a large body of representative engineers and a large and interesting section of the country. Hotel rates are to be reasonable at $1 a day and up for room alone, or $2 a day and up American plan.

BOOKS AND BOOKLETS

STANDARD HAND BOOK FOR ELECTRICAL ENGINEERS, second edition, New York, 1908. 1,300 pages, full leather binding, 4 by 7 inches, price $4.

This book has been well received by the electrical fraternity, as is indicated by the fact that the first edition is in the sixth thousand. It covers the entire field of electrical engineering, taking up units, electric and magnetic

circuits, measurements and measuring apparatus, properties of materials, magnets, transformers, electric generators, electric motors, batteries, central stations, transmission and distribution, illumination, electric traction, electro chemistry, telepathy, telegraphy, wiring, standardization rules and miscellaneous applications.

Few changes have been made in the text of the book, but the paper is lighter, making less bulk, many of the plates have been remade and the binding is given even greater flexibility than before, an important point in the mechanical makeup of a handbook. A thumb index by sections has also been added. It is a book for designers and investigators rather than operating engineers and those engaged in actual construction.

STEAM-ELECTRIC POWER PLANTS, by Frank Koester. New York, 1908. 450 pages, 8 by 11 inches, fully illustrated and with numerous double page plates. This is a practical treatise on the design of central light and power stations and economical construction and operation. It takes up the location of plants, the general arrangement, the storage of coal, the supply of water for condensing, excavation and foundation, the building proper, the boiler room installation and chimneys, feed-water heaters and superheaters, high-pressure and low-pressure piping, prime movers, including reciprocating engines, turbines and their auxiliaries, the electrical equipment and the testing of power plants. The work includes descriptive discussions of typical American and European light and power plants. This is in all respects a careful and thoughtful work written by a man well fitted for the task. While it is, in the main, intended for consulting rather than operating engineers, yet mathematics is avoided so that anyone can read it understandingly and can get from it the necessary information to enable him to supervise the erection of a plant. Nothing particularly new is embodied in the book nor does it attempt to advocate novelties, but it is a good and reasonably complete record of modern standard practise. Perhaps the chapter on piping has more material in it that has not appeared in condensed form in print than any other single section of the book, and this subject is one which has not been at all adequately treated in engineering literature. Scattered through the book are bits of useful information that are not easily to be found. For instance, in the section on cooling towers are given some dimensions per 100 pounds of exhaust steam condensed that have not been found in print. Also in a chapter on the design of small power plants the subject is treated from the standpoint of the little fellow up to 2,000 kilowatts capacity, whereas most treatments of this subject are only for stations of thousands of kilowatts. The book is well worth the price charged for it, $5.

STATIONARY ENGINEERING, by Joseph G. Branch. Three volumes, Chicago, 1908. Cloth, 6 by 8 inches.

Volume 1 is on steam boilers and attachments. It covers the subjects of combustion, boiler installation, boiler accessories, boiler management, types and specifications of boilers, and leading types of boiler and furnace attachments. The book treats of standard boiler room practise in this country, is adapted for the use of the beginner in engineering, and has at the end of each chapter a series of questions and answers which serve to fix in the mind of the reader the facts that he has learned.

Volume 2 has for its subject Steam Engines, Heating and Electricity. The chapter on boilers for heating purposes is rather more elaborate than the name indicates, as it treats of steam and hot water heating, specifications for heating systems, pipe installations, and rules for janitors and firemen. The section on the steam engine takes up the plain D valve type of engines, setting the D valve, governors, valve gears, condensers, compound engines and pumps, dealing with each of these subjects in detail both as to the principles and the commercial machinery now in use. The section on electricity is somewhat meager, consisting of 3 chapters, 1 devoted to electricity and magnetism, 1 devoted to the theory and construction of dynamos and motors, and the third to the operation of dynamos and motors.

Volume 3 treats of elevators, mechanical refrigeration, and steam turbines. The chapter on elevators takes up steam, hydraulic and electric types and tells of safety devices, pumps, tanks, pipes and fixtures. A chapter is also introduced on the steam engine indicator, showing the essential parts and method of using the indicator with various kinds of reducing motions. Mechanical Refrigeration takes up a description of ice machines, the operation and testing of machines, the difference between direct and brine systems, artificial ice manufacture, and piping for cold storage houses. The chapter on the steam turbine treats of the purpose of the machine and gives descriptions of the principal modern types. All volumes have the questions and answers and each volume has a very full index.

FROM THE DODGE MFG. CO. of Mishawaka, Ind., comes a neat device for quickly finding the speed of belting, the diameter of pulleys and power transmitted. It consists of a slide and celluloid case which shows these values simply without figuring.

TESTS OF CONCRETE AND REINFORCED CONCRETE COLUMNS is the title of Bulletin No. 20 issued by the University of Illinois Engineering Experiment Station. This records the results of a series of tests made in 1907 to determine the value of steel hooping as compared with the longitudinal rod enforcement.

MASSACHUSETTS FAN CO., Watertown, Mass., has just issued an exceedingly attractive booklet entitled Davidson Ventilating Fans. The illustrations show both pulley fans and many types of electric fans driven by standard motors of various makes. These are applicable for the economical movement of large volumes of air at moderate pressures.

THE SQUIRES REDUCING VALVE, made by the Strong, Carlisle & Hammond Co., of Cleveland, Ohio, is illustrated and described and a chart showing its uniform action reproduced in a folder just received from that company.

LUMINOUS RADIATORS consist of an ornamental cast iron frame fitted with a polished copper reflector at the back and with 3 or more large cylindrical incandescent heating lamps, and are described in an attractive pamphlet recently issued by the General Electric Company, Scenectady, N. Y.

EDWIN BURHORN, of 71 Wall St., New York, has for a long time made a specialty of the design and erection of cooling towers for condensing plants and ice manufacturing plants. Two types are installed, the Burhorn and the Acme, features of which are protected by patents. These towers are built of steel and galvanized iron, the frame of the tower being of structural shapes rigidly braced, and the cooling surface of a galvanized wire mesh. A booklet recently issued gives descriptions of a number of installations, with several interesting tables in regard to tests, the advantages of using a condenser with the steam engine or steam turbine, and a discussion of the action of cooling towers.

ALLIS-CHALMERS CO., of Milwaukee, has just issued an interesting book on the works and products of that company. It shows by pictures of the works in various cities what a really enormous capacity the company has for turning out work, and by photographs of apparatus built what enormous work the company turns out. The lines manufactured are direct and alternating current generators and motors, reciprocating steam engines, steam turbines, pumping engines, electric pumps, hydraulic turbines, gas engines, mining machinery, cement-making machinery, flour mill machinery, sawmill machinery, air brakes and air compressors. Copy of the booklet will be sent to anyone interested on request.

ALBANY GREASE is the subject of a booklet issued by Adam Cook's Sons, 313 West St., New York City. In this booklet are described the different brands of Albany Grease, also the special grease cups which are supplied by the manufacturers for use with it. Price lists of the different styles of cups are included and explanation given of the different places where the various brands should be used. Copy of this booklet can be had on application.

BATES MACHINE CO., of Joliet, Ill., is sending out a handsome catalog describing the Cookson feedwater heaters and receivers. The illustrations show interior views of the shop, sections of the heater showing the oil separating and sediment catching plates, views of the different sizes of heaters and drawings showing the elevations of the different styles built. The heater is made in a simple form and also as combination heater and receiver, with different arrangements for various puroses. The older type is a round wrought iron shell, but an all cast-iron heater of square shape is also described in the catalog, which is as handsome and attractive as it is instructive.

GENERAL ELECTRIC CO. motor is described in detail in a 16-page bulletin issued by the company at Schenectady, N. Y. This motor is for direct-current circuits and is made up to 20 hp. in size, and for voltages of 115, 230 and 550.

IN BULLETIN NO. 4576, General Electric Co., Schenectady, N. Y., describes the Type F Form K-3 line of oil switches for panel installation and remote control. This compact, durable and reliable oil switch has been especially designed with a view to combining every element of satisfactory operation with low price, and is claimed to meet the most severe requirements of severe service on systems of 4500 volts or less. The switches are provided with overload release, nonautomatic; with overload release having coils connected in series with the main circuit, automatic; and those with overload release having coils connected in the secondaries of current transformers, also automatic.

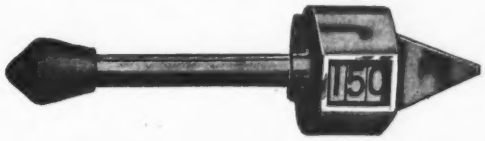
BOILERS is the title of an interesting catalog issued by the Traylor Engineering Co., of New York City. This describes in detail the Hawkes water-tube boiler showing the construction, the setting and the advantages. This boiler has many novel features and may be used with either brick setting or steel jacketed casing.

UNDER THE NAME OF THE Tungsten Economy Diffuser, the General Electric Co., Schenectady, N. Y., is placing on the market a new form of illuminating device. The Tungsten lamp makes the incandescent unit a competitor for lighting larger areas than was previously possible, and by properly diffusing the light a very effective and economical illumination is obtained.

TRADE NOTES

ALWAYS HAS THERE been a demand for a small vest pocket speed counter which is accurate and durable. The speed counter, here illustrated, is one that is said to have these qualities. It is of the same size as the illustration, being not quite 3 inches in length.

While it is very small and convenient to carry, it



is by no means fragile. It registers the exact number of revolutions, only requiring one to take the initial reading and subtract it from the final reading to obtain the number of revolutions.

This unique and handy tool has been placed on the market by The American Steam Gauge & Valve Manufacturing Co., 206 Camden Street, Boston, Mass.

THE OHIO BLOWER CO., Cleveland, Ohio, reports recent sales of Swartwout steam specialties as follows: One 30-in. cast-iron exhaust head to The Shenango Furnace Co., Sharpsville, Pa.; 1 14-in. to Buffalo Steel Co., Buffalo, N.Y.; and 1 of the same size to The Rookery Bldg., Chicago, Ill., to replace a galvanized head; others to the Hamilton Organ Co., Chicago, Ill., The Waterbury Castings Co., Waterbury, Conn., Geo. W. Carmichael & Co., Painesville, Ohio, Bloomer Brothers, Newark, N. J., Board of Education, St. Louis, Mo., Jones & Laughlin Steel Co., Pittsburgh, Pa., The National Hotel, Washington, D. C., John C. Sulton Co., San Francisco, Cal., American Steel & Wire Co., Cleveland, Ohio, The Sears & Nichols Co., Chillicothe, Ohio, Merril Brothers, Maspeth, N.Y., Great Lakes Dredging Co., Port Arthur, Ont., and J. P. Eustis Mfg. Co., Boston, Mass.; a 6-in. horizontal oil separator to The Liquid Carbonic Co., New York, N. Y.; horizontal steam separators to Indiana Harbor Belt R. R. Co., Gibson, Ind., Western Electric Co., Hawthorne, Ill., Whiteville Lumber Co., Whiteville, N. C.; and vertical steam separators to Standard Oil Co., Rahway Refinery, N. J., The Waterbury Castings Co., Waterbury, Conn., Malta Vita Pure Food Co., Battle Creek, Mich., Eldorado Brewing Co., Stockton, Cal., The Superior Water, Light & Power Co., Superior, Wis., St. Marks Hotel Co., Oakland, Cal., and the Jeffrey Mfg. Co., Columbus, Ohio.

RUBBER TILING FOR FLOORS of public buildings has many advantages as it gives water-proof cover, one of great durability and which is noiseless. After having examined carefully the merits of interlocking rubber tiling, Andrew Dall & Son, of Cleveland, Ohio, have recently placed with the New York Belting & Packing Co., Ltd., an order for this tiling to be installed in the Cuyahoga County Court House, Cleveland, Ohio. This order, which is believed to be the largest ever placed for rubber tiling, amounts to $125,000. It will be laid in the large court rooms, corridors, judges' chambers, anterooms, etc., in varied designs to conform to the color scheme of the rooms. Lehman & Schmit are the architects for the building.

IT WOULD APPEAR from the number of contracts for standard Allis-Chalmers electric motors and generators received during the month of May, that the demand for more power facilities in all parts of the country is making headway daily against panic-

bred conservatism. With each month's sales from the first of the year showing considerable gains over the month preceding, the outlook is decidedly encouraging.

A number of recent contracts from various sections which bear out this statement are as follows: The city of Lawrenceburg, Tenn., is a recent purchaser of a 250-kw. Allis-Chalmers water wheel type alternator and exciter, together with a complete AB arc lighting outfit. The Washburn Crosby Co., Minneapolis, which installed a 1500 kw. steam turbine unit, has added a 200 hp. induction motor to its power equipment. The Natural Food Co., of Buffalo, will install a 150 hp. induction motor of standard design, recently ordered. The Pratt Light and Ice Co.,Pratt, Kans., is a recent purchaser of a 100 kw. and a 50 kw. generator with excitors and a 50 hp. motor. The New Jersey Consolidated Water & Light Co., at Elberon, N.J., has ordered a 175 kw. belted alternator. The Standard Hosiery Co., of Philadelphia, will install 28 induction motors ranging from 2 to 50 hp. in capacity, in its Lawrence Street plant. The Great Western Portland Cement Co. has ordered a new 800 kw. generator for installation in the plant at Mildred, Kan., which already contains Allis-Chalmers crushing and cement making machinery. A 1500 kw. Allis-Chalmers turbo alternator will be installed in the Dan River Cotton Mill, Danville, Va., and the Citizens Elec. Co., of Williamsport, Pa., is to install a new 300 kw. engine generator unit. The Pend D'Oreille Elec. Co., of Sand Point, Idaho, recently let contracts for a 225-kw. Allis-Chalmers engine generator unit with exciter and switchboard, and the Philadelphia Electrical Construction Co., of Philadelphia, purchased for John Williams Mfg. Co. 2 16 by 36 in. Allis-Chalmers engine direct connected to 150 kw. generators of the same make.

BEGINNING WITH JULY the Engineer and Fireman, published by the Penberthy Injector Co., Detroit, Mich., will be increased in size and will have 80 pages of instructive and interesting reading matter on power plant subjects. Free sample copy will be mailed to any reader of Practical Engineer upon request.

BUCKEYE BOILER SKIMMER CO. has received from The Central Dredging Co. the following letter:

"We are just in receipt of a report from our superintendent, Mr. H. B. Whitney, of Swea City, Iowa, in regard to your skimmer. Here is what he says: "Washed dredge boiler after 3 weeks run. No mud or scale and could have run 3 weeks longer. Our usual run was 5 to 6 days. The Skimmer is a complete success."

THE WESTINGHOUSE MACHINE CO., builders of the Roney Mechanical Stoker, reports for the first 2 months of this year a good demand for stoker equipment. Perhaps the most interesting orders have come from cold storage companies. The Merchants Ice & Cold Storage Co., of Cincinnati, are installing 3 equipments; the Montgomery Ice & Cold Storage Co., Jenkintown, Pa., 2 equipments; and the Holt Ice & Cold Storage Co., Indianapolis, Ind., the same number. Another municipal lighting station at Troy, Ohio, operated by the Board of Public Service, has adopted Roney stokers, and the Pennsylvania Light, Heat & Power Co., of Allegheny, Pa., operating a large central station at that place, increases its present equipment with 2 stokers of large capacity.

RECENT SALES OF THE SWARTWOUT ventilators, manufactured by The Ohio Blower Co., Cleveland, Ohio, include a third order from the Richardson Paper Co., Lockland, Ohio, for 7 more 36-in. and 8 more 24-in. ventilators. The first order was for 6 36-in., the second for 26 24-in. and 7 36-in. This now makes a total of 54 ventilators sold to this company within a period of 90 days.

A NEW DEVICE now being placed on the market is an emery wheel dresser with a safety hood to protect the operator in case of accident to the dresser

wheels and to keep fine particles of emery from being thrown into his face and eyes. This device is offered by J. L. Neefus, of New York City.

WANTED

"Positions Wanted" advertisements not exceeding 50 words for subscribers to Practical Engineer will be inserted twice free of charge. "Help Wanted" and special advertisements 25 cents a line.

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As chief engineer. Experienced with steam engines and turbines. Best references as to character and ability. Address L. FitzSimmons, 162 Palmer St., Kokomo, Ind. 6-2

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Engineers, Firemen, Electricians, Machinists, etc. New 25-page pamphlet containing questions asked by Examining Boards sent free upon request. Address, Geo. A. Zeller Book Co., 4467 W. Belle Place, St. Louis, Mo. Established 1870. 4 tf

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Engineer wants position as hoisting engineer, cableway preferred. Sober and can give references. State wages. Address Ben Mast, Greentown, Ind. 5-2

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The new revised edition of the Modern Engineer's Hand Book. A $2.50 Book by mail on receipt of 50 cents. Be quick. Address, W. H. Ermentrout, 514 Elm Street, Reading, Pa. 4 tf

PATENTS

C. L. Parker, Late Examiner, U. S. Patent Office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 Dietz Bldg. Washington, D. C. 4 tf

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60 steel storage tanks, 6,000 gallons' capacity. Good as new. Double riveted, extra well built. Suitable for storage of oils, waters or liquids of any kind. 100 steam pumps. Get our prices on engines, boilers and electrical machinery. All sizes and kinds. Chicago House Wrecking Co., 35th and Iron Sts., Chicago. 4 tf

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